QUARTERLY JOURNAL OF METHODS AND INFORMATION FOR TEACHERS OF SCIENCE

117 ✓

The SCIENCE COUNSELOR

Volume IX ★ Number 3 ★ Sept., 1946

DUQUESNE UNIVERSITY PRESS


COORS
U.S.A.
CHEMICAL AND SCIENTIFIC
Coors is best
by every test
PORCELAIN WARE
COORS PORCELAIN COMPANY
GOLDEN, COLORADO

The Science Counselor

"FOR BETTER SCIENCE TEACHING"

A QUARTERLY JOURNAL *of teaching methods and scientific information especially for teachers of science in Catholic schools. Published at Duquesne University, Pittsburgh, Pennsylvania, in March, June, September and December by*

THE DUQUESNE UNIVERSITY PRESS

Subscription Price: $1.00 per year; Canada, $1.25. Single copies of issues in the current year, 35c each. Business and Editorial Offices at Duquesne University, 901 Vickroy Street, Pittsburgh, Pa.

Volume IX September, 1946 No. 3

CONTENTS

Writing for Publication

Thought, energy and care go into the writing of a paper for publication, even a brief and simple paper. But the author is well compensated, even though he receives no financial remuneration for his work.

The writer benefits because he must clarify his thought in order to state his ideas plainly. He must give attention to logical arrangement as well as to lucidity and effectiveness of expression. Perhaps he may find it necessary to restudy in detail the whole topic with which his paper deals in order to invigorate his thinking and bring his information up to date. He will be induced to read more widely than he otherwise might, thereby broadening his knowledge and strengthening his understanding. In his reading he will meet fresh minds that stimulate him.

All this is sufficient to repay the writer for the pleasures he may forego in order to publish, for writing takes time as well as effort. But there are other satisfactions. The prolific writer as well as the novice enjoys seeing his thoughts expressed on the printed page. All authors take pleasure in knowing that their writings may aid others in their study, thinking or work.

Have *you* published a paper lately? Have you one in mind? What about reporting the scientific research or the educational experiments you conducted last year? Is it not selfish to keep secret the useful teaching "tricks" or devices you have invented or adapted? Have you found new ways of doing old things? What is commonplace to skilled teachers, a beginner may find novel and helpful.

The Science Counselor desires to encourage new and inexperienced writers. Careful consideration is given to every manuscript submitted. Why not begin planning a paper now?

One more thought. Writers seldom learn of the gratitude of those who benefit from their publications. Readers who have been informed, aided or inspired by an article usually do not take the trouble to express to the writer their thanks and appreciation.

A sincere statement of approval—or of disagreement—pleases an author. We hope our readers will not forget this kindness.

Which article in this number helped or interested you most?

Should you thank the writer?

Federal Aid to the Unknown

• By Senator Elbert D. Thomas
CHAIRMAN, SENATE MILITARY AFFAIRS COMMITTEE, WASHINGTON, D. C.

On July 3, 1946, the day this paper was written, the Senate passed by a vote of 48 to 18, S. 1850, the bill mentioned in this paper. It had the active and cordial support of Senator Thomas. It was referred to the Subcommittee on Public Health of the House Committee on Interstate and Foreign Commerce where, on July 19, it died an ignoble death. The 79th Congress adjourned without establishing a National Science Foundation.

Differences of opinion among scientists and misjudgments which resulted in regrettable legislative maneuvering have been blamed for the demise of the bill.

When the legislation, so greatly desired by most scientists, is revived in the next Congress, it will receive as before the whole-hearted advocacy of the Senator from Utah.

Never before in the history of this nation has so much attention been paid to the needs of scientific development as during the months past.

From the overwhelming evidence that this nation is at the crossroad, and that present action will determine how rapidly we penetrate the unknown frontier of science, a new concept has arisen.

It is the general acceptance that the federal government must assist in the world of science. Months of study and questioning of our foremost scientists, educators and others have strengthened that concept.

Testimony has been almost unanimous that our scientific needs cannot be met without federal aid.

Congressional action has been urged by spokesmen for government, education, labor, clergy, agriculture, medicine and science.

In his message to Congress last year, President Truman stressed the importance of legislative action.

Studies by subcommittees of the Military Affairs Committee and the Commerce Committee have proved beyond doubt that a program of federal aid is imperative. We believe it is necessary to the public health, the public welfare, to scientific education, and to the nation's defense.

The latter point was forcefully stated by Secretary of War Patterson, who testified that America "can not lag in the laboratory and hope for any chance of victory in the event of a future war."

Needs in medical research, the nation's welfare and the restoration of our scientific talent and skilled personnel were graphically shown in the historic document, "Science, the Endless Frontier," a report to the President by the famed Dr. Vannevar Bush, Director of the wartime Office of Scientific Research and Development.

From science came the great medical advancements lowering the death rate in the Army from 14.1 per thousand in the last war to 0.6 per thousand in this. Dysentery, tetanus, typhoid, paratyphoid, yellow fever, these were virtually conquered. But ahead lie the great problems of cardiovascular disease, accounting for 45 per cent of all deaths in this country, the infectious diseases, cancer, even the common cold.

For the public welfare, there is the whole range of potential discoveries such as have developed the automobile, radio, radar, affected the fields of electronics and aerodynamics, providing a higher standard of living and millions of jobs.

As to the deficit in trained research personnel resulting from the war, the estimate is that this nation is short 150,000 students who would have received bachelor's degrees, and 17,000 advanced degrees, by 1955.

The latter shortage affects chemistry, engineering, geology, mathematics, physics, psychology and the biological sciences.

New applications will result from new discovery. Here, in the field of *basic* research, the need is greatest. In 1938 some $270,000,000 was spent on research of all kinds in America, but only one-seventh for fundamental research. England spent about the same amount for basic and applied research.

Applied research has the progressive force of commercial and industrial interest, but only five per cent of the great industrial budgets for future research is estimated to be devoted to basic research.

Research in the natural sciences, largely dependent upon universities, has been made possible by traditional private endowments and state appropriations. The evidence is that heavy taxes have removed private funds and that state appropriations cannot meet the need.

These are the factors behind the growing sentiment for federal support of science. We have worked diligently to avert any possibility of affecting the freedom of science through federal *control* of science. The proposals would nurture the flowering of basic knowledge, not constrict it.

The President has recommended a budget of $40,000,000 for the first year of such a program, which would expand in time to about $100,000,000.

(Continued on Page 94)

The Electron Microscope in Biological and Medical Research

• **By Francis O. Schmitt, Ph.D.** *(Washington University)*
DEPARTMENT OF BIOLOGY, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE, MASS.

This up-to-the-minute paper deals with the recent advances in biology and medicine that have been made by using the electron microscope, a new research tool.

Pathogenic and non-pathogenic bacteria have been examined. Plant and animal viruses have been studied. Protein molecules have been visualized directly. Carbohydrate fibers have been inspected.

Dr. Schmitt describes how the electron microscope works, and explains the techniques by which the biological studies have been made. He predicts that ". . . we are on the threshold of the greatest era of discovery in the entire history of biological science."

●

It has long been known that the smallest object which can ever be resolved by a light microscope has a size about half the wave length of the light used to illuminate the microscope. We can never expect to resolve objects smaller than about 0.2 microns (1/25,000 inch) with visible light, or about half this size with ultraviolet light.

The really significant structure of living cells and tissues is in the colloidal, submicroscopic range which, it was supposed, could never be visualized directly. Various indirect methods of analysis of submicroscopic structure were devised, including polarized light microscopy and x-ray diffraction; application of these has contributed greatly to our understanding of the molecular structure of protoplasm.

However, following the publication of deBroglie's important theory of the wave nature of electrons and Davisson and Germer's proof of its correctness, a new field of electron optics was opened up. The "light" in this case is a beam of electrons generated by a hot filament and accelerated by an electrical potential. The lenses are either cylindrical electromagnets equipped with pole pieces, or metal sheets of appropriate geometry across which a potential may be placed. These magnetic or electrostatic lenses focus the electron beam, hence make possible the magnification of the image of an object placed in the lens system.

It is an interesting commentary on the speed with which fundamental scientific discoveries are reduced to practical application that hardly more than a decade after the physical principles were discovered, electron microscopes were manufactured and placed on the market. Only a few years after the first German instruments were made, The Radio Corporation of America offered its instrument for sale in 1941. Since then, two new RCA models have been brought out and several hundred instruments are already in use.

Using the large RCA instrument as our example, let us trace the electron beam after it leaves the hot filament at the top of the microscope column. Accelerated by about 50,000 volts, the beam is concentrated on the object by a condenser lens. The beam then traverses the objective lens which magnifies about one hundred times. Near the bottom of the column is a projector or ocular lens which furnishes additional magnification of about 100, giving a total magnification of 10,000. These figures are actually conservative, for the magnification may be more than double this figure. At the bottom of the microscope column the electrons produce an image on a fluorescent screen which is viewed through glass ports. Focusing is accomplished by adjusting the current in the magnetic lenses. When the image is in focus the fluorescent screen is moved aside, causing the electrons to fall on a photographic plate. Exposure times are usually of the order of 10 to 20 seconds.

Careful distinction must be made between magnification and resolution. The magnification of the image on the plate may be only 10,000, yet the resolution is such that this electron micrograph may be enlarged another ten times, giving a useful magnification of 100,000 or more. With appropriate materials, resolution of 25 Angstrom units (about 1/10,000,000 of an inch) or about 100 times greater than the resolution of the light microscope, has been obtained. This is about the length of a single molecule of fat. In certain exceptional cases it has been reported that particles only about half this size have been resolved.

It is necessary to pump the inside of the microscope to a good vacuum to avoid scattering of the electrons by air molecules. Anyone who has attempted to drive an automobile in a dense fog will understand how the rays of the headlights are scattered rather than being focused on the road. In this case the light rays are scattered by the water droplets of the fog. The necessity of evacuating the microscope column means that specimens become thoroughly dried. This is a serious handicap in the examination of biological objects. The biologist must be very careful to take this into account in interpreting the meaning of his electron micrographs, for biological objects are usually highly aqueous, and drying is likely to lead to grave alterations of structure.

Another limitation derives from the fact that the electron beam (at 50,000 volts accelerating potential) has very low penetrating power. Hence specimens must be very thin. Biological objects, which contain chiefly light elements, should not be thicker than about 0.1 microns, or about 1/250,000 of an inch. Indeed, much ingenuity is required to prepare material in a form thin enough for examination without destroying the organization of the object to be studied. High speed microtomes have been devised by which tissues and other bulk materials may be sectioned to sufficient thinness and further technical advances in this direction may be expected.

A clever method has been devised to support the specimen in the microscope column. Thin, 200-mesh wire grids are provided which have diameters of about ⅛ inch to fit into the specimen holder. Onto these grids is deposited a film of collodion about 100 Å thick. This is accomplished by first forming the thin film on the surface of water in a trough by placing a drop of collodion dissolved in amyl acetate on the water surface. The drop immediately spreads to a thin film. By immersing the grids in the water and bringing them through the film, the film is transferred to the grids thus providing a very thin support for the biological specimen which is then placed on the film and allowed to dry. The specimen grid is then placed in a cylindrical holder and inserted in the microscope so that the specimen is suspended in the optical axis just above the objective pole piece. The microscope is then closed, pumped to the proper vacuum and the specimen examined. A mechanical stage permits movement of the grid in two dimensions so that objects in a number of squares between intersecting wires on the grid may be examined. When suitable objects are found they are carefully focused and exposures made. After each exposure the current in the objective and projector coils is read from meters. By reference to calibration charts this permits determination of the magnification of each micrograph.

It has recently become possible to examine the surface of large opaque objects. After cleaning and etching the surface a thin film of plastic in solution is spread and dried on the surface. The plastic film, which is a replica of the surface to be studied, is then examined in the electron microscope. Variations of this replica technique have already made possible the examination of the surface structure of metals and other solids including bones and teeth.

Though electron microscopes became available in this country only about five years ago, several hundred scientific papers have already been written on electron microscopy, and an active society, The Electron Microscope Society of America, holds regular meetings to advance the science.

In biology and medicine great advances have already been made. Microorganisms of all kinds have been examined, including many pathogenic and non-pathogenic bacteria. Particularly important are the studies which have been made of plant and animal viruses. These structures are very much smaller than bacteria, hence are ideal for study with the electron microscope. They cause many serious diseases such as poliomyelitis, rabies, encephalitis and others. During the war important advances were made in the study of influenza virus. Such electron microscope studies are of great practical importance in the control of disease for, when the causative agent of a disease can be visualized, ways to control the disease are much more readily devised than when the nature of the agent is unknown.

Not only are tissue cells subject to invasion and destruction by viruses but by bacteria as well. Bacterial viruses are called bacteriophages. Electron microscope studies show that the bacteriophage possesses a small head and a thin short tail, resembling a tadpole. Within the head are structures which are probably of nucleoprotein nature. Indeed most of the viruses and other biological structures which readily reproduce themselves contain nucleoprotein, the substance thought to be closely associated with the ability of chromosomes to reproduce themselves.

Only a relatively short time ago it was supposed that molecules would never be visualized directly. However, the electron microscope has already revealed not only some of the larger protein molecules, like hemocyanin, but several smaller ones as well.

The new technique of shadow casting is extremely valuable in dealing with these small particles. Proteins are composed of light elements like C, H, O and N, hence produce very low contrast in the electron micrograph. To observe objects like protein molecules it is necessary to increase the contrast by the deposition of heavy atoms which have high electron stopping power. To do this the preparation is placed in an evacuated chamber in which a tungsten filament is placed some inches away from the specimen. In the filament there is a small bit of heavy metal, usually gold or chromium. When the tungsten filament is heated sufficiently the heavy metal is vaporized. The metal atoms travel in straight lines. Falling on the specimen, the metal piles up on the windward side of objects—such as protein molecules—and casts a shadow on the leeward side. After exposure to the metal rays the specimen is withdrawn from the evacuated chamber and examined in the electron microscope. The high contrast produced by the metal shadow gives a sort of three dimensional aspect and makes detection of small particles much easier. With further refinement of the shadow-casting technique, we may expect to learn much about the finest details of many important biological structures.

The electron microscope has made possible great advances in our understanding of the structural basis of cellular organization, the fibrous proteins. With the help of electron stains, i.e., compounds like phosphotungstic acid which combine with the protein and possess atoms of high electron stopping power, fine details of structure of the protein have been discovered. Fibrous proteins which have been thus studied include collagen (the

(Continued on Page 90)

Virus Diseases of Plants

• By W. C. Price, Ph.D. *(Columbia University)*
DEPARTMENT OF BIOLOGY, UNIVERSITY OF PITTSBURGH, PITTSBURGH, PA.

Notable advances have been made in recent years in the study of the widespread plant virus diseases which destroy fruits and garden vegetables, tobacco, and sugar cane. Virus diseases curtail man's production of foods, ornamental plants and fibers.

In this paper, a well-known expert reports the latest developments in the field. Dr. Price discusses the classification, history, properties, transmission and control of the diseases, and the isolation and study of certain viruses.

The study of plant viruses should give us a better understanding of human viruses. Whether viruses are living or non-living is still unsettled.

The term *virus*, according to most dictionaries, generally means any exudate or poisonous material used for communicating infectious diseases.

For the specialist, however, *virus* has a much more specific meaning for it refers to a particular class of infectious agents. These agents, at least those that have been sufficiently studied, are known to be of extremely small size—from about one to ten millionths of an inch in diameter—far too small to be seen even under the highest powered light microscope. They are thus much smaller than the bacteria or the protozoa or the fungi that cause other types of disease in plants and animals. In addition, they are capable of growing only within living cells of a susceptible host. Many attempts have been made to grow viruses in cell-free cultures, but no one has yet succeeded in doing so. Some of these tiny infectious agents are responsible for such dread diseases of man as smallpox, yellow fever, infantile paralysis, measles, and sleeping sickness; others cause disease in domestic and wild animals; and still others infect plants.

Plant virus diseases may be grouped according to the symptoms they produce. The largest group consists of the mosaic diseases, which are so-called because of the mottling, resembling a mosaic, that occurs on the leaves of infected plants. Irregular patches, light in color, are interspersed haphazardly over the darker green background characteristic of the normal leaf. The color of these patches may vary from yellow-green, only a little lighter than normal, to a very brilliant yellow. In the latter case, infected plants are often highly ornamental in appearance. *Abutilon thompsoni*, which is prized in some circles as an ornamental because of its brilliantly mottled foliage, is no more than a mosaic diseased *Abutilon striatum*.

The next largest group includes the *yellows* diseases. These are characterized by chlorosis and by the abnormal growth of adventitious shoots, which are usually more slender and more nearly erect in habit than normal. In these diseases, flowers develop abnormally and are often colorless and usually distorted.

Another is composed of the ringspots in which zonate, more or less circular, spots develop on the foliage. Then there is the gall-disease group characterized by various sorts of tissue proliferation, the dwarf-disease group in which extreme stunting or dwarfing occurs, and the leaf-roll group the principal feature of which is conspicuous rolling or curling of leaves.

Virus diseases of plants are widespread and destructive. Most of them do not kill their hosts outright, but so reduce yields as to make the growing of infected plants unprofitable. The curly top disease of sugar beets, caused by a virus, was so prevalent and destructive in 1929 as to cause the abandonment of 10,000 acres of beet culture in California. Sugar production in Louisiana dropped from 400,000 to 50,000 tons mainly as a result of the effect of sugar cane mosaic on the crop. Peach yellows at one time threatened the growing of peaches on the eastern seaboard as far south as Virginia, and the phony disease of peach has endangered the crop in the remainder of this region from North Carolina to Florida. The peach X or yellow red virosis, a recent arrival, has caused large losses in areas where it is prevalent and quarantine measures are now taken to prevent its spread to other areas. Tobacco mosaic occurs wherever tobacco is grown. It is estimated to cause an annual loss of from 35 to 45 million pounds of tobacco in the United States alone.

Virus diseases of plants have undoubtedly existed for centuries but they have been known to man for only a relatively brief period. The earliest published account is that of Carolus Clusius, in 1576, on tulip *breaking*, a condition in which the anthocyanin pigment is distributed irregularly in stripes or streaks up the center or about the margins of the petals. Today, breaking is recognized as one of the symptoms of mosaic, but at that early date it was considered a stage in the development of a normal plant. Consequently, until fairly recently, broken tulips were highly prized by growers for their ornamental value and many fancy methods were devised in attempts to induce breaking. It is of interest that bulb grafting, which is now known to transmit the disease, was first practiced, in 1675, by Blagrave. However, Blagrave's contemporaries did not look with favor on this process and it was not practiced extensively. Since the discovery of the infectious nature of tulip

mosaic and its devitalizing effect on its host, attempts have been made to eradicate the disease rather than to spread it.

Among the most famous of all plant virus diseases is tobacco mosaic, although it has been known only since about 1869. In 1886, Mayer, in Holland, showed that the disease could be transmitted from diseased plants to healthy ones. In 1892, Iwanowski, a Russian, found that when the sap from diseased plants was passed through filters having pores fine enough to prevent the passage of all known bacteria, the filtrate was still capable of inducing mosaic in healthy plants. In spite of this, Iwanowski held to his original belief that the disease was caused by a bacterium, suggesting that the filtrate contained a bacterial toxin that produced symptoms in inoculated plants. It therefore remained for a Dutchman, Beyerinck, in 1898, to prove that the infectious principle itself was filterable and to propose the theory that it was a *contagium vivum fluidum*, a theory that was to dominate the thinking about viruses for the next twenty years. In the same year, Loeffler and Frosch showed that the infectious agent of foot-and-mouth disease of cattle would also pass bacteria-proof filters. As a result of these discoveries, the infectious agents of these diseases came to be known as *filterable viruses*, a term which was also applied to other viruses whether or not they had actually been shown to be filterable. The filterability of an infectious agent likewise came to be used as the chief characteristic for distinguishing virus diseases from other types of diseases.

Although no virus was obtained in pure form until 1935, much progress was made in understanding the diseases caused by viruses and in determining their properties. In 1901, Takami showed that the stunt disease of rice could be transmitted from diseased to healthy plants by means of a leafhopper, *Nephotettix apicaulis*. This observation was made only a year after Reed and his co-workers had demonstrated the transmission of yellow fever by a mosquito, yet it was not until many years later that the role of insects as vectors (carriers) of plant virus diseases became fully appreciated. Today it is recognized that nearly all virus diseases of plants are spread in nature by the feeding habits of insects. The insects, effective in the transmission of plant virus so far as investigators have been able to track them down, are distributed among the thrips (Thysanoptera), leafhoppers (Heteroptera), psyllids, white flies, and aphids (Homoptera), gall mites (Arachnida), and bettles (Coleoptera). Of these, the aphids and leafhoppers are by far the most frequent offenders.

Insects act in two different ways to transmit plant viruses: in one case, they can transmit immediately after they have fed on a diseased plant and they retain the ability to transmit for only a few hours unless they again have access to infected plants. The viruses involved are known as *non-persistent* viruses, and the insects as *non-persistent* vectors; in the other case, the insects are not able to transmit immediately after feeding on diseased plants but only after a delay of from several minutes to 2 or 3 weeks, and they retain the ability to transmit indefinitely. Viruses so transmitted are known as *persistent* viruses, the vectors as *persistent* vectors. The transmission of viruses by non-persistent vectors is believed to be merely a mechanical affair, the mouthparts of the insect, which come into contact with virus as the insect feeds, are contaminated with virus which is then introduced into the next few plants that the insect feeds upon. Transmission of cucumber mosaic by the aphids *Aphis gossypii*, *Macrosiphum gei*, and *Myzus persicae* and by the beetle *Diabrotica duodecimpunctata*, of bean mosaic by the aphids *Myzus persicae* and *Macrosiphum pisi*, and of sugar cane mosaic by *Aphis maidis* is of the non-persistent type.

The persistent vectors, in contrast to the non-persistent ones, are, for the most part concerned in the spread of viruses that are not mechanically transmissible. Transmission of aster yellows by *Cicadula divisa*, of corn mosaic by *Perigrinus maidis*, of maize streak by *Cicadulina mbila*, and of peach yellows by *Macropsis trimaculate* is of the persistent type. It has been shown by Kunkel, and by Black, that the virus of aster yellows actually multiplies in its insect-vector, a period of from 14 to 28 days being required after the insect feeds upon a diseased plant before it is capable of infecting healthy ones. This period is spoken of as an *incubation period* and is believed by some to represent the time necessary for multiplication to take place in the insect vector. Others hold that the incubation period is merely the time the virus takes to travel from the mouth to the gut, thence through the gut wall into the blood, and finally into the salivary glands. No doubt, the route outlined is the one taken by the virus in the vector when it becomes infective, but it has not been shown that the length of time required for this movement is sufficient to account for the incubation period. It was observed by Storey that active and inactive races of *Cicadulina mbila* differ only in the permeability of the

EXPLANATION OF FIGURES →

1. Western yellow blight of tomato caused by sugar beet curly top virus. The plant on the right is healthy. Comparison of the two plants gives an impression of the destructiveness farmers in the curly top region have to contend with. (Photograph by J. A. Carlile)

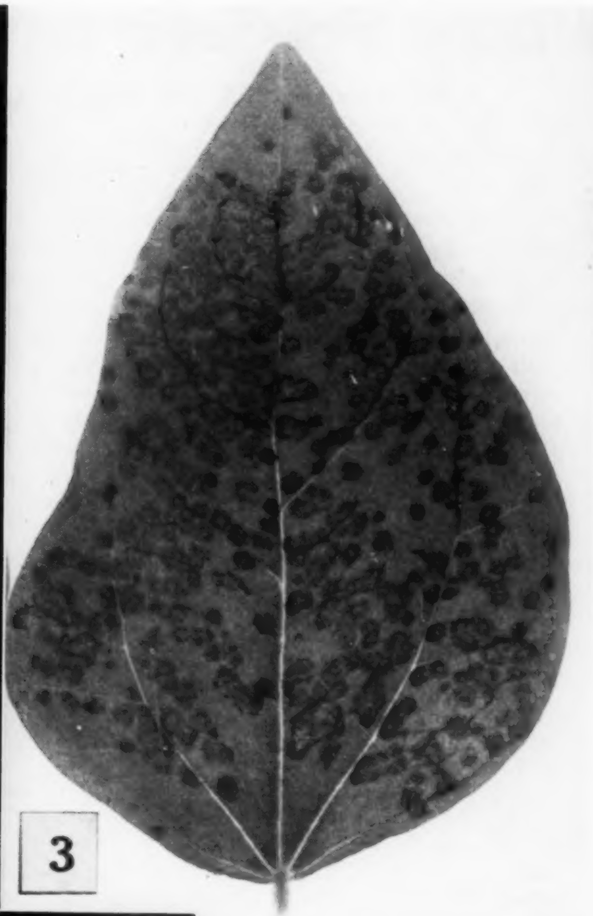
2. Symptoms of a yellow mutant strain of alfalfa mosaic virus in tobacco. The diseased plant from which this strain of virus was derived showed only a single bright yellow spot; the yellow mosaic virus was isolated from it. Such bright yellow mosaics are often ornamental and frequently prized by gardeners. (Photograph by J. A. Carlile)

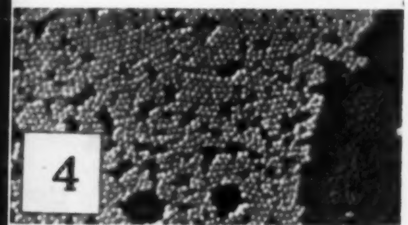
3. Necrotic lesions produced by rubbing a solution of tobacco necrosis virus over a leaf of a cowpea plant. Since the number of such spots is a function of the virus concentration, they are useful in measuring virus activity and permit studies to be made of such phenomena as the physical properties of viruses, their rates of movement, and their multiplication. (Photograph by J. A. Carlile)

4. Electron micrograph of the elementary particles of tomato bushy stunt virus. These particles are only about 26 millimicrons in diameter. Here they have begun to come together in an orderly fashion, the beginning of crystallization. (After Price, Williams and Wyckoff. Arch. Biochem. 9, 175 (1946), magnification 61,000 X)

5. Elementary spherical particles of southern bean mosaic virus, which are only about 32 millimicrons in diameter, have here been arranged in an orderly manner to form crystals. Individual particles are far too small to be seen at this magnification; one of the larger crystals contains about 270 billion of them. (Photograph by J. A. Carlile, magnification 280 X)

(Continued on Page 88)





Explanation of these Figures is given on page 70.

Plant Science in a Garden

• By Frances M. Miner, M.A. (New York University)
CURATOR OF ELEMENTARY INSTRUCTION, BROOKLYN BOTANIC GARDEN, BROOKLYN, N. Y.

Most school children, like many adults, really like to garden when "Gardening is a creative experience, not a synonym for a hard and monotonous chore."

The growing of food and flowers helps provide a solution for the increasing demand that schools shall function twelve months a year. Many a school now idle in summer could provide instruction in gardening if the desire to do so could be awakened in teachers and pupils. It was the hope of stirring such interest that prompted the Editor to request this paper.

For 33 years the Brooklyn Botanic Garden has taught children to learn the ways of plants by working with them. Some of the results of that long expereience are embodied in this delightfully written article.

●

Hopping and skipping they come along the wide walks of the Botanic Garden to the white gate under the rose arch.

Some heads scarcely show above the privet hedge, for Warren and David and Marcia are only eight and nine years old and are just beginning their explorations into the world of plants. Teddy is not much taller, but he is a "veteran" of half a dozen seasons in the Children's Garden. Caroline and Martin are towering high school students anxious to make up in their first summer for all they have missed in the years before they heard about these classes for boys and girls. Enthusiasm runs high and learning about plants is definitely on the "fun" side for these youngsters, although visitors often comment on their serious attitude toward their work, and every one of the two hundred and forty children enrolled would probably agree with Larry that it takes a great deal of patience and hard labor to make a garden. Nevertheless, attendance records indicate their loyalty.

Since the early years of the Brooklyn Garden, an area of the grounds has been set aside for the exclusive use of the Department of Elementary Instruction. It has always been the aim to have a productive, well-kept garden, but the children themselves have been the primary concern of the project. What they can learn of plants by living with them is of greater importance than all the hundredweights of string beans and green vegetables, or the thousands of root crops or even the ton of tomatoes harvested each year. However, crop is tangible evidence of success, and success is an important element in any favorable learning situation. Horticultural methods to improve the soil and to increase the yield have been sought continuously, and details of organization and instruction have been planned to give the children as much freedom of choice and action as possible while enabling them to grow plants with a reasonable chance of success.

Experience is the greatest teacher in this school. Adult guidance helps the children avoid some of the mistakes that are more costly of time than money perhaps, for plants grow with the season. "Too late" this year often means "next year" before the right season comes again. Modern children are well acquainted with material playthings and mechanical gadgets, but proper treatment of a living plant is less familiar knowledge. Experience, rather than the pages of a book, teaches the skill and understanding of this art, but while children are learning, almost anything can, and frequently does, happen in the garden where they are working.

Early in the spring, former students re-register for places in the Garden, and new applicants from a waiting list are admitted to fill the roster for the season. The activity is limited only by the size of the field available, not by the enthusiasm or the number of applicants that appear without benefit of advertising. Classes meet on Saturday mornings for six or eight sessions prior to the outdoor planting date. New students learn to recognize the seeds they will be using and study the planting plan that is prepared for them for gardens 8 by 10 feet in size. The more experienced gardeners prepare their own planting plans, for gardens slightly larger. In the greenhouses they sow seeds and transplant all the tomato, pepper, celery, lettuce and onion seedlings needed for the garden, as well as hundreds of flower seedlings.

In late April, as soon as the land is ready for planting, the older boys working with the staff divide the field into one hundred twenty-six numbered plots marked with corner stakes. Children are assigned with partners of their own choosing, if possible, and after Planting Day, instruction is given individually or to small groups of gardeners. Matters horticultural occupy most of the Saturday mornings of May and June. Weeding, cultivating, thinning, and finally first harvests of radishes, scallions and spinach are followed by subsequent replantings of those or other crops. The children would like to come to the Garden more often than once a week, but coming as they do from fifty or more schools in all parts of the Borough, such a plan is not practical until the summer holiday. During July and August and until the Friday before schools open in September, many of the boys and girls manage to spend three or four mornings a week helping with the general maintenance of the permanent plantings in the children's area after their own plots are in order.

(Continued on Page 87)

Some Thoughts on Evaluation for Science Teachers

• **By Victor H. Noll, Ph.D.** *(University of Minnesota)*
PROFESSOR OF EDUCATION, MICHIGAN STATE COLLEGE, EAST LANSING, MICH.

This is a very wise and very practical and very helpful discussion of teacher-made evaluation instruments, written by a trained scientist and an experienced teacher of teachers.

Young instructors should heed its every word. Those long in the teaching field will be pleased to see their own experiences crystallized and expressed succinctly.

Truly we should know, not something, but much "about good evaluative procedures so that we may not spoil a job of good teaching by inadequate or poor evaluation."

●

Those engaged in the education of our youth seldom realize what an important phase of this work evaluation* is, and how much of it they do. Neither do they always appreciate the extent to which the purposes of instruction are often determined by the evaluation instruments used. Standardized tests and state-wide or regional testing programs have been severely criticized because it is said that teachers make such tests the objectives of their instruction. They are said to forget their boys and girls and to concentrate on having them make a good showing on those particular tests.

Although the purpose of this article is not to discuss such testing programs, it must in all fairness be said that they have probably done some good in setting standards or goals, especially for weaker schools. It should also be noted that when a pupil prepares himself sufficiently well to pass a stiff examination he is not entirely wasting his time.

The main point to be brought out by the foregoing is that evaluative devices do play an important part in the educative process. Like any other techniques they can serve good purposes or bad purposes. It behooves us as teachers, therefore, to know something about good evaluative procedures so that we may not spoil a job of good teaching by inadequate or poor evaluation. The main purpose of this article is to offer a few practical suggestions to science teachers for the improvement of their evaluation procedures.

The first suggestion is to make the techniques serve the purposes of instruction. In order to do this it is necessary to know what our purposes are and to state them in terms of the learner rather than the subject. Rather "to develop the ability to solve problems by use of the scientific method" than "to cover the next ten pages"; rather "an understanding of a scientific principle, such as the conservation of energy" than "to pass an examination on chapter six".

A functional viewpoint on evaluation also demands a wide variety of techniques. All purposes cannot be served by one type of examination. Knowledge, skills, and attitudes require different approaches in testing as well as in teaching. Some enthusiasts for objective tests have gone to the extreme of recommending that essay questions no longer be used. The emphasis should be rather on a more effective use of a wide variety of techniques. Essay questions do have a place, and teachers can learn how to make better ones and to grade them more accurately and consistently.

Another suggestion is to evaluate more frequently. All too common is the practice of testing only at the end of the semester, or perhaps only two or three times a semester. A variety of tests, including tests of performance as well as paper and pencil tests, and pupil self-evaluation devices as well as teacher-rated tests, will add interest to the work and give the teacher a broader and therefore sounder basis for evaluating the growth of the pupil. More frequent and more varied testing also helps to motivate in that the pupil is kept informed of his progress and also of his weaknesses on which he may seek assistance.

In addition to such general suggestions, a few more specific ones for the improvement of teacher-made evaluation instruments may be mentioned. First, as regards essay questions, the following are likely to be found helpful:

1. Use the words discuss, explain, describe, etc., sparingly. Use more of the short answer and simple recall type, such as define, list, name, etc. This not only makes grading easier but it helps the pupil to think and express more precisely and accurately.

2. Use a larger number of shorter essay questions in preference to a few longer, more comprehensive ones. This tends to make for wider, more thorough sampling of the pupil's learning.

3. In marking essay questions try to be impersonal. It is a good idea to have the pupils write their names on the backs of the papers and for the teacher to evaluate the work without reference to whose paper is being graded. It also helps for the teacher to write out the answers before reading the papers and to use them as

(Continued on Page 83)

*The term evaluation is used here to include a wide variety of tests, scales, rating devices and other techniques of measurement and appraisal.

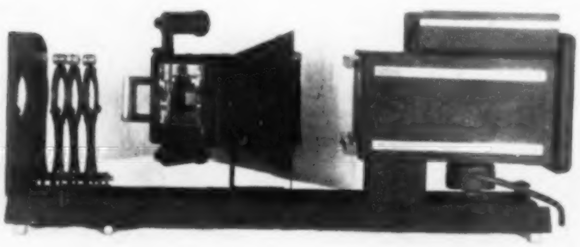
Better Service from Lantern Slides

• **By Lloyd W. Taylor, Ph.D.** *(University of Chicago)*
HEAD, DEPARTMENT OF PHYSICS, OBERLIN COLLEGE, OBERLIN, OHIO.

Teachers know that small slides (2" x 2") cannot be shown in a fully illuminated room, yet many schools must use them because of the high cost of standard slides and their projectors.

Dr. Taylor tells how the problem has been solved through the inventive ability of a retired high school teacher who discovered that illustrations printed on cellophane can be shown satisfactorily, using inexpensive projectors that have simple uncorrected lenses. Both slides and projectors will soon be available commercially.

Every science teacher who wants to keep up to date will be interested in this new development in visual education.



A NEW AND INEXPENSIVE PROJECTOR

If to see an illustration in a newspaper or magazine one had to interrupt his reading and darken the room, then illuminate the room again before resuming his reading, how extensively would such illustrations be used? To ask the question is to answer it. Only a few utterly indispensable illustrations would ever appear, certainly not more than one per cent of those which now enrich our reading.

Yet this is precisely the handicap which we impose on the use of screen illustrations in classroom instruction, where visual aids are even more valuable than in general reading. The teaching tool which is potentially the richest and most fertile aid at all educational levels is being frustrated by this awkward procedure. Only when a picture can be flashed on the screen at the touch of a button at the teacher's desk, bright enough to compete successfully with the excellent illumination typical of modern classrooms, shall we be in a position to take full advantage of the enormous asset that illustrations bring to the educational process.

This is perfectly possible today, with standard sized (3¼" x 4") lantern slides. It is only the smaller slides, whether of the 2" by 2" or of the 35-mm. filmslide variety, that cannot be shown in a fully illuminated room. In our preoccupation with these smaller slides, we have placed an insuperable handicap on the effective use of one of our most valuable educational resources.

The pronounced swing in recent years to smaller slides is a consequence of the high cost of standard slides and their projectors. With all their advantages, only a radical reduction in cost will make it possible to put a projector in every classroom and a really adequate collection of slides at the ready disposal of every teacher. Such a development is entirely feasible. The processes are now being commercialized. The production of slides and the design of projectors that will cost only a small fraction of the corresponding products on the market today have been perfected by Charles F. Dutton, a retired high school teacher of Cleveland.

The cost of lantern slides is conditioned primarily on the fact that they are produced by photographic process. If they could be produced by a printing press, their cost could then be brought into the price-range of printed material and out of the price-range of photographs. Mr. Dutton devoted himself for several years to solving some of the problems of printing such illustrations on cellophane. The problem of reproducing half-tones remains to be solved, though poster-type pictures in color are perfectly feasible. But even diagrams, biological and perspective drawings, maps, tabular material, and the like will be very helpful to the teacher. We are informed that they will soon be available.

The other aspect of the problem is the projection. Most of the cost of the modern projector is in the objective lens. Corrected lenses, mounted in telescope tubing with rack-and-pinion focusing devices are unavoidably expensive. It is no discredit to the manufacturers that teachers have insisted on such unnecessary refinements. For their own good they must realize that they have been putting vital educational aids beyond the reach of their school budgets, and be prepared to accept less in order that they may have more.

The fact is, as almost any teacher of general science has observed in the laboratory, that very tolerable quality may be attained by projection with simple uncorrected lenses. Such lenses in sliding mounts cost only a few per cent of what the conventional objective lens costs. The aberrations, while visible to the teacher, are scarcely if at all distinguishable at the distance of the student. It is on this basis that Mr. Dutton has developed the projector illustrated herewith. Like the slides, its commercial development is promised soon. In the form illustrated, it provides for the projection of 2" x 2"

(Continued on Page 96)

Bird Banding on a College Campus

• By Rev. John Willard Baechle, C.PP.S.
DEPARTMENT OF BIOLOGY, ST. JOSEPH'S COLLEGE, RENSSELAER, INDIANA

Licensed by the government as a bird-bander, an important work in the official study of the migratory habits of birds, the writer of this paper is well known throughout the Middle West through his writings, his entertaining illustrated lectures, and the widespread newspaper attention that has been given his work.

The little practiced activity of bird banding gives the biologist an excellent opportunity to study birds and to participate as well in a government research project of importance.

Audubon is usually credited with having been the first person in America to band birds. About 1803, he used silver wire to mark a brood of Phoebes, and the following year he found that two of the marked birds returned to nest in the same vicinity.

Little is known of bird banding activities from that time until a century later when, in December, 1909, the American Bird Banding Association was organized. In order to expand and further promote this valuable phase of ornithology, the United States Biological Survey took over the project in 1920. From that time until the end of 1945, a period of 25 years, a total of 4,833,442 individual birds of over 430 different species were banded, and a total of 346,237 *Return* records were reported. At present, bird banding is under the supervision of the Fish and Wildlife Service, Department of the Interior, Washington, D. C. A few years ago there were 1,600 persons in the United States engaged in this project, and as soon as the Fish and Wildlife Service is able to obtain more clerical help, it is hoped that the number of active bird banders may be increased greatly.

Every authorized bird bander must obtain a Federal permit, and in some states, he must likewise have a state permit in order to capture and band song birds. The banding of waterfowl and other game birds is restricted to government game preserves. All bird banders must be at least 14 years old, and must furnish proof, in the form of testimonials, that he is sufficiently acquainted with birds to easily recognize the species common to his locality. He must also either own or have access to books on the identification of birds so that he can correctly identify any strange birds he may catch. All banders are warned against banding any bird about whose identity they are not certain.

The bands to be used come in about ten different sizes, and are furnished by the Fish and Wildlife Service in the quantities requested by the bander. The bands are made of aluminum, and on each is stamped the inscription, "Notify Fish and Wildlife Service, Washington, D. C." This inscription is abbreviated and stamped on the inside of the smaller sized bands. Each band likewise has a number stamped on it. This number begins with two digits to indicate the year the band was issued, and then, separated by a hyphen, are from four to six other digits. No duplicate numbered bands are ever issued. Special form blanks, for sending in the semiannual report on newly banded birds, special cards for reporting *Return* birds, as well as envelopes, which require no postage, are furnished each bander. There is no charge for the permits, bands, report blanks and envelopes, but neither is there any pecuniary recompense for the work done by the banders.

Each bander must furnish his own equipment in the form of traps, bird food, etc. A copy of "Manual for Bird Banders" by Frederick C. Lincoln and S. Prentiss Baldwin is furnished to each bander. This manual gives descriptions and diagrams for the constructing of many types of approved traps with which to catch the birds without harming them. It likewise gives instructions for the proper handling of the birds along with various ways of attracting them, and a table indicating the proper size of band to be used on most of the common species of birds to be banded.

Some of the interesting facts about birds which have been and still are being discovered through bird banding, as enumerated by Lincoln and Baldwin, are as follows:

1) MIGRATION—When do certain species arrive in a

The author (left) takes a portrait of a Robin while a student holds the bird close to the camera.

given locality and when do they leave? Is the same route followed for both the spring and the fall migration? Do birds return to the same winter and summer quarters? What effect has weather, *e.g.*, a storm, upon migration? Do males, females, and young travel together, or, if separately, which comes or goes first?

2) Territory—What is the range-limit during the breeding season? What is the limit during the winter or other seasons?

3) Ecological Preferences—What is the preferred habitat of various species? Can certain species be attracted away from their preferred type?

4) Family Groups—What is the length of time that the unity of the family is preserved?

5) Permanent Residents—Are so called 'permanent residents' the same individuals, or is there a movement of greater or less extent in such species?

6) Mating Activities—Does polygamy, polyandry, or inbreeding take place? Which species breed when one year old? What part is taken by both sexes in nest-building and the care of young? When is incubation begun, and do the eggs hatch in the order in which they were laid? What is the number of broods per season?

7) Longevity—What is the normal length of life of different species as shown by yearly returns?

8) Personality—Do individual birds have peculiarities in appearance, habits, and manners?

As to various methods of capturing the birds, trapping them is the most common, but there are other methods, such as finding young birds still in the nest, and catching them at night with the aid of a flashlight and net. The type of trap and kind of food used for bait will naturally vary according to the kind of bird to be caught. We have about 20 traps of four different types on the campus of St. Joseph's College. The traps must be located where they can be inspected about every hour lest the captured birds injure their beaks or feathers by being held captive too long. During the nesting season the traps should be visited even more frequently so that the parent birds are not detained too long and as a result either the incubating eggs or the young neglected. I find it quite easy to enlist a number of my biology students to aid in the work, especially during the migration periods, and when banding is resorted to. These students also keep me posted as to the location and progress of the many nests on our extensive campus.

Young birds are usually banded a few days before they are ready to leave the nest. The same sized band must always be used on nestlings as would be used on an adult bird of the same species. Every year we band several hundred birds of the following species, Purple Martins, House Wrens, Barn Swallows, Robins, Mourning Doves, and Blue Jays. With the help of several students we have erected on our campus five large Martin houses with a total of over 70 compartments. We have likewise made and erected over 50 Wren houses. Next year we hope to build and place quite a few Blue Bird houses, too.

This bird is alive. Many birds will lie still for quite some time if the hand is opened slowly.

Catching birds at night is another phase of banding which we indulge in and enjoy very much. During the migration seasons especially, we capture many birds with the aid of a flashlight and net. On one occasion we caught six different species in less than one hour, while the birds were roosting in a small grove of evergreens. There are a few species which we have caught only at night, because they never frequent our traps. Most of the Starlings which we have banded were caught at night while they were roosting in our dairy barn. On one occasion two of us caught over 140 Starlings with our bare hands within 20 minutes. We usually 'raid' the Martin Houses about three times each spring before the birds begin to nest. Since Martins never frequent the traps, this is the only way we can capture the adults and thereby catch the birds which were banded several years before.

If a banded bird is caught within three months of its previous capture at the same banding station, such a bird is called a *Repeat*. The presumption is that the bird has been in the vicinity all the time. If more than three months elapse between two successive trappings of the same bird, such a bird is called a station *Return*. The presumption in this case is that the bird had been away from the locality and had returned. If a banded bird is either caught or found dead at a great distance from the banding station, such a bird is called a *Recovery*.

We began to operate our banding station at St. Joseph's College on April 12, 1941. During the slightly more than five years since that date, we have banded over 9,500 individual birds of 78 different species. Over 3,000 birds were caught as Repeats, and 179 birds were caught as station Returns. Our number of Recovered birds, however, is rather low, for only 30-odd birds banded by us have ever been reported to Washington as having been caught or found dead elsewhere.

(Continued on Page 90)

The Place of Science in the Education of the Consumer

• By Nathan A. Neal, M.A., *(Columbia University)*
RADIO STATION WBOE, BOARD OF EDUCATION, CLEVELAND, OHIO

"Good buymanship is essential for optimum living." But our schools do not teach how to buy, use and maintain.

Cognizant of the situation, the National Association of Secondary School Principals, in cooperation with the National Science Teachers Association and other groups, in 1942 began an important Consumer Education Study which resulted in the publication recently of a Report entitled "The Place of Science in the Education of the Consumer".

Mr. Neal, chairman of the N.S.T.A. Committee on Consumer Education, discusses certain of the findings embodied in the Report, a modest publication that will influence teachers and textbook writers for many years to come.

The Consumer Education Study of the National Association of Secondary-School Principals was initiated in 1942 with two chief purposes: (1) to investigate what should be taught and how it could best be organized and objectively presented; (2) to facilitate the work of the schools by providing instructional materials.

From the beginning it was recognized that while consumer education may require some subject matter indicating new courses, in the main it is an emphasis on a set of purposes which gives a "slant" to a larger part of the curriculum. It was presupposed that even in the schools where special courses have been organized for the achievement of these purposes, much of what is truly consumer education would necessarily continue to grow out of other courses and activities.

Various subject matter groups, organized on a nationwide basis, have cooperated with the Study. These include organizations in social studies, home economics, mathematics, and business education. In the autumn of 1944, representatives of the newly organized National Science Teachers Association met with representatives of the Consumer Education Study to make plans for a bulletin on contributions to consumer education which may most effectively come from the field of science. The bulletin was planned to analyze the nature and purposes of consumer education in general; to show the relation of science education to the total consumer education program; to present those elements which science teachers can most expertly contribute; and finally, to suggest to administrators and teachers something of organization and methods of instruction in the area concerned.

In the autumn of 1945, a 32-page Report entitled, "The Place of Science in the Education of the Consumer," was released cooperatively by the Consumer Education Study and the National Science Teachers Association. This publication has been distributed by both groups. Both of these organizations may be addressed at 1201 Sixteenth Street, N. W., Washington 6, D.C.

The literature of consumer education has accelerated enormously in the past decade. This trend is rooted deep in fundamental changes in our economic life and in the problems of our society. Factors which demand attention to education in consumership have grown in importance as the nation has moved further in the direction of a scientific industrial technology and a complex exchange economy. The average individual and family of today buys a higher proportion of goods and services used than ever before. Good buymanship is essential for optimum living. The number and variety of goods and services threaten the incompetent consumer with confusion, and in some cases actual waste of his resources. To one educated consumerwise, today's variety of goods and services may lead to better living. This situation seems to place a premium on consumer education.

Other needs in the area of consumer education are evident. The increasing complexity of goods and services calls for added intelligence not only in purchasing, but equally in proper use and maintenance. There is often a wide gap between scientific facts and the beliefs held by consumers. Lack of scientific understanding may prevent intelligent choice and use of foods, vitamin products, medicines, mechanical devices, and electrical appliances, to mention only a few products. Sometimes the limited science knowledge possessed by consumers is exploited to their disadvantage by pseudo-scientific advertising and sales promotion. Continued consumer welfare demands education to bring about a more intelligent use of some of our natural resources which have been used up at an unprecedented and frequently alarming rate in recent years. Consumer education in this area could well be aimed at the elimination of waste and, where practical, at provision for a continuing supply. Consumers need to know the truth about our nation's potential ability to produce goods and services in amounts never before thought possible, in amounts sufficient to supply the needs of all.

In a section dealing with the need for consumer education, the Report states:

> "Consumer education must help the young consumer to be a more intelligent, a more effective, and a more conscientious member of the economy in which he lives. He needs to be intelligent in de-

veloping a fine set of values to guide his actions; in using his resources of time, energy, money, and capital goods; in finding and using reliable sources of information; in applying the findings of research to his consumer activities; and in understanding the operation of our system of production and distribution and the basic economic priciples upon which it rests. He must be effective in the ordinary skills which make for competency in purchasing and using goods and services; in managing his financial affairs; in providing some goods and services for himself and his family; and in working in an organized fashion for desirable reforms. Finally, he must develop such attitudes as will lead him to put his beliefs into practice; to work for the common good and for what is best in the long run, rather than for immediate and selfish gain; to avoid exploitation, whether of businessmen, workingmen, farmers, or of his fellow-consumers; to study thoughtfully what government should do and to back his decisions with action; and to work for conservation of material and human resources.*

Science has many values in consumer education. There is a growing school of thought which holds that any science worth teaching for any reason has value in the education of consumers. The committee of science teachers which developed the Report limited itself largely to suggestions on selection and organization of subject matter directly connected with the continued production, puchase, preservation, and use of goods and services. Within this framework the committee set forth four major contributions which science teachers may make: (1) to help students to use science in making wiser decisions about purchases; (2) to help students to employ science in the effective use or operation of goods and services; (3) to help students to use science in improving their own production for home use; and (4) to aid pupils in the wider applications of the methods of science to the solving of consumer problems.

Illustrative materials for use in consumer education are discussed. Science education aimed at consumer values should emphasize those goods and services which account for a high proportion of consumer expenditures. Attention should be given to any goods or services, the purchase or provision of which is—or seems—highly and immediately important to the student. Some items on which the total sum spent is not great may be of outstanding importance or present special difficulties to the purchaser. These are worthy of attention. It is definitely true that crowded courses of study make it imperative that science education aimed at consumer values should emphasize only those phases of consumer education which science teachers are especially or uniquely able to present.

The areas of health remedies and services, recreation through hobbies and special interests, and certain aspects of food, housing, and clothing problems are examples of areas in which science teachers have special contributions to make to consumer education values. Knowledge of bacteria and sanitary methods are important with food standards. Vitamin pills and capsules are most useful to the consumer who understands their values and limitations. Kinds and qualities of materials for construction are important in good housing along with knowledge of fuels, insulation, paints, and plumbing maintenance and operation. The complexity of materials in textiles, furs, and footwear make proper selection and care of these items a scientific problem. The avoidance of overpriced, worthless, or dangerous drugs, devices, and cosmetics is more probable in the presence of basic scientific knowledge. The fundamentals of self medication and the intelligent purchase of health services are areas in which scientific knowledge may be of great practical value. Other examples are included in the Report.

The committee's statement on curriculum organization is strongly in favor of biology, physics, chemistry, and other established courses of the secondary school being given a definite consumer education slant. It is pointed out that this arrangement is the simplest from an administrative standpoint since science teachers alone will be involved in making a shift of emphasis. When this arrangement exists science teachers may organize the consumer material about the basic principles of science which already form the course. As second choices and for consideration in special situations, there are possibilities for a course labeled "Science in Consumer Education;" for a separate unit on consumer education to be made a part of each of the major courses in science; or for consumer education to become one of several large areas about which the work of a considerable part of the school program may be integrated.

The methods to be used in teaching consumer science are not likely to be very much different from those which have been found useful in other phases of science teaching. A few typical lines of approach are suggested. These include: pupil participation in planning; introducing consumer education work in science through immediate community problems; working through individual or family problems; utilizing clubs for consumer values in science; using the contribution of experts, and other teaching methods.

There is a place for the project method in teaching consumer science. One suggestion is a forestry project which might take the direction of planting a forest for the school or community; assisting a farmer to establish a wood lot; or introducing living Christmas trees in the community. Another is a community food locker project which involves basic science from the fields of physics and biology. A third deals with air pressure and consumer education. This latter project includes materials on pumps, compressed air, and reduced air pressures in their relationships to well-known devices and applications in every day living.

In proposals for further action the Report points out the need for controlled research to determine which approach is most effective in meeting consumer needs

(Continued on Page 94)

*For a more comprehensive definition of consumer education, see Appendix B of "The Modern American Consumer," published by the Consumer Education Study.

How Much are Plants and Animals Alike?

• **By Sister Mary Ellen O'Hanlon, O.P., Ph.D.** *(University of Chicago)*
CHAIRMAN, DEPARTMENT OF BIOLOGY, ROSARY COLLEGE, RIVER FOREST, ILL.

This paper continues a discussion begun in our June number.

The nutrition, respiration, growth and regeneration of plants and animals have already been compared and contrasted.

Here, grafting, sexual reproduction, embryos and cells are considered. This material warrants careful study.

Part II

Grafting

Skin grafting is successful in the higher animals and in man. In general, however, the principle of grafting is quite limited in the higher animals; but in many of the higher plants grafting is a regular horticultural practice. There are various types of plant grafting in use, but in their essentials the principles are the same.

The crown of a young tree may be grafted on to the trunk or lower part of a stock tree, provided only that the two parts are from trees which are closely related and that their cambium layers make contact. Whether the scion be the complete crown or only a branch or a bud, it becomes a definite part of the new unit formed through the union of the stock plant and the scion. The interplay, including conduction, the translocation of food materials and the elaborated food, is exactly the same in the two parts of this new-formed individual plant as though they had not once been parts of two distinct plants. The scion must not, therefore, be regarded as a kind of parasite on the stock plant, for it does the photosynthetic work and carries on the other processes proper to its organs. Thus it contributes to the growth and nutrition of the underground part, proportionate to the amount of the aerial part that it includes. This is sometimes all of it, according as the scion is the whole crown of the grafted plant. The scion bears leaves, flowers and fruits according to its individual heredity, although these organs may sometimes be ostensibly modified because of the internal environment created through the interplay of the stock and scion. The roots and all other parts of the stock, too, may be influenced by their interrelations with the scion. Both stock and scion, nevertheless, retain their individual hereditary constitutions. Thus, according as the cells of the stock or of the scion may function in the reproduction of new plants, they will pass on only the hereditary characters which were peculiar to each in its original condition; that is, their chromosomal contents will remain constant.

Experimental grafting in animals has been successful more or less only in proportion to the natural regenerative power which the animals possess. It may be, however, that surgical skill and practice in postwar times will make significant advances in this field also.

Sexual Reproduction in Plants and Animals

The natural and normal method of reproduction in all higher animals is definitely and exclusively bisexual. In higher plants there is always at least the evidence of a potential sexual method, although in a relatively few cases this method is not functional and may be substituted for or supplemented by a sexual method. Some of these asexual methods are more or less specialized, while others are purely vegetative.

Out of its natural habitat, the sweet potato ordinarily does not even bear flowers; and the white potato, another native of tropical America, seldom bears fruit in this climate and is regularly grown from cuttings of its tubers.

Well-known cultivated plants, such as the banana and the pineapple, must be regularly propagated by vegetative methods, because these plants do not develop any functional seeds in their fruits, if such structures as the abortive ovaries of the pineapple may be called fruits. The seedless oranges and seedless grapes are also parthenocarpic and the plants are therefore cultivated from cuttings or grafts.

Unlike the higher animals, there are several modifications of the sexual reproductive process in the angiosperms. Perhaps the best known of these is unreduced parthenogenesis, a phenomenon common in the dandelions and the hawkweeds. Although parthenogenesis occurs among the invertebrates, such as rotifers, certain insects and some of the lower crustaceans, there are no normal parthenotes among the vertebrates.

Relative to the distribution of the organs which develop the gametes in the angiosperms there is also considerable variation. Many of the plants bear perfect flowers; a few are polygamous (some of the maples). There are certain angiosperms which bear both types of imperfect flowers on the same plant (monoecious); and, finally, there are many dioecious species, such as the willows, poplars, ashes, and the boxelder.

Some of the seed plants do not respond readily, if at all, to vegetative methods of propagation, and therefore can survive only through the development of their seeds. This is true of many of the gymnosperms, including the pines and some of their allies. There are other plants which, whether they develop seeds or not, can reproduce their kind vegetatively or by special asexual

methods. It seems that the higher seed plants lend themselves to asexual or vegetative methods of reproduction more or less in proportion to their regenerative powers. This appears to be true whether or not they have retained their sexual methods of reproduction and no matter how specific these may be, for example, the apple or the clovers. From an evolutionary point of view, this is significant, because in general the gymnosperms are considered more primitive than the present angiosperms. It suggests, therefore, that after sex evolved to its peak in some of the angiosperms, it gradually became less functional and is no longer essential to the survival of some of them, for example, the banana and the pineapple. The contrast between plants and animals in reproductive functions is probably as great as it is in their nutritional habits.

Plant and Animal Embryos

We shall consider here only a few of the details which characterize the plant embryo and distinguish it from the animal embryo. The discovery of sex in plants was long superseded by a fair and general knowledge of the biology of sex in animals. Much of the terminology which had been in use relative to reproduction in animals was then taken over wherever it seemed to apply to similar processes in plants. The result is that with a rather ponderous terminology that is often quite inaccurate, there is much confusion about the real nature of these processes as they are exemplified in the higher organisms especially.

A typical embryo, whether that of a plant or of an animal, begins its existence with a fertilized egg—often called a zygote. The term zygote, as well as that of egg and sperm, therefore, is applicable to representatives of both kingdoms. The origin of the eggs and sperms, however, is quite different in the plant and in the animal. In the higher plant the sex cells are produced through mitotic division of certain mother cells of the gametophyte generation—the generation which normally bears only the N or monoploid number of chromosomes in its cells. The gametophyte generation has no counterpart in the animal kingdom.

The animal sperms and eggs are developed from primordial germinal tissue, the cells of which, like the somatic cells, are 2N. The process by which animal sperms and eggs are developed is called gametogenesis. In the final stages of gametogenesis (maturation) the method of cell division is called meiosis. This is the process in which one of the two successive divisions is reductional; and although each normally bears the monoploid number of chromosomes, the eggs and sperms of plants and animals are of quite different origin.

Reduction division in all of the higher plants normally occurs in the process called sporogenesis; so the typical spore cell is monoploid. This spore on germination, gives rise to the gametophyte or N generation of the plant. Alteration of generation is characteristic of all of the higher plants, as well as many of the thallophytes.

The phenomenon in the animal which may be compared with alternation of generations in the plant, is known as *metagenesis* and is sometimes called alteration of generations. Metagenesis is particularly conspicuous in some of the coelenterates in which the medusa or jellyfish phase alternates with the hydroid or polyp phase. That is, the medusa produces the polyp by the sexual method and the polyp produces the medusa, asexually, by budding. The plant gametophyte produces the sporophyte by the sexual method and the sporophyte produces the gametophyte asexually through spores. The cytological difference in the alternation process in plants and animals is, however, very significant. Both generations in the animal life cycle are 2N, and there is no stage in it which corresponds to the spore. The reductional division also is at gametogenesis, just as in all other animals. There is therefore no cytological alternation of generations in the metagenesis of animals but only a morphological one; whereas the essence of a normal alternation of generations in plants is cytological.

Among the unfortunate terms which have been applied to some of the plant organs are: *ovule*, *ovary* and *placenta*, to cite the most confusing perhaps. The animal ovary is a gland from some of whose cells are matured the ova or animal egg cells; the so-called ovary in the plant is the basal part of a highly specialized leaf, called a carpel or *megasporophyll*. The plant ovary is therefore an enclosure for the ovules ("little eggs"),[1] each one of which is morphologically, a *megasporangium*. In due time within the nucellus of the ovule, four megaspores are developed from a megaspore mother cell, by the matùration or reduction process.

Usually only one of these megaspores is functional. In the typical angiosperm this megaspore germinates and gives rise to several cells or nuclei (usually eight) within the megaspore cell wall. The megaspore wall is later called the embryo sac. The embryo sac, together with the cells it contains forms the *megagametophyte*. One of the cells within an embryo sac is the functional egg; that is, it unites with one of the two sperms which enter the embryo sac by way of the pollen tube.[2] Two other nuclei within the embryo sac fuse to form the fusion nucleus, which then unites with the second sperm to form a 3N nucleus from which the endosperm tissue is subsequently developed.

In some species the endosperm may serve as stored food which is used by the young plant when the seed

[1] The so-called ovule is much more than a little egg and, according to its morphology, is better called a megasporangium.

[2] The male gametophyte *(microgametophyte)* in the seed plant takes its origin from the microspore which, before it is shed from the microsporangium (pollen sac) undergoes certain development after which it is called a pollen grain. The pollen grain, therefore, a partially developed microgametophyte, continues development on the stigma of the pistil, and the pollen tube is that part of the male gametophyte (microgametophyte) which conducts the sperms to the embryo sac. The pollen tube and the antheridium of lower plants both bear sperms and they both belong to the gametopyte or N generation in the plant life cycle. The testes or spermaries of animals, on the contrary, are glandular organs of 2N tissue from which sperms are developed by gametogenesis similar to gametogenesis in the tissue of the animal ovary.

sprouts, as in the corn kernel; or it may be used immediately by the developing embryonic plant and stored in its cotyledons, as happens in the bean seed type. This young plant enclosed within the embryo sac is further surrounded by certain tissue of the "ovule" (nucellus) which (according to the species) may or may not persist. Finally, the integument of the ovule metamorphoses into the seed coat or testa. The whole seed thus formed is fastened by a stalk (the funiculus) to the region of the ovary wall called the placenta.[1]

It is therefore readily seen that it is a far cry from the placenta of an animal to the structure of the same name in the plant. Such terminology could have been adopted only because at the time so little was known of the complicated structure of the seed and fruit.

The *sine qua non* of the seed is the embryonic plant which it contains: the seed however is more than just the embryo; it is made up of a number of parts which differ cytologically and also according to their descent. The embryonic plant itself represents the 2N generation, speaking cytologically, and, according to its descent, it is of the filial generation. The embryo sac which surrounds the embryonic plant is the remains of the gametophyte and therefore is of the N generation. The stored food in the form of endosperm is 3N tissue and, like the embryo, according to its descent, it is of the filial generation. The nucellus (if any of it remains) and the metamorphosed integuments of the "ovule" (megasporangium) constitute 2N tissue and are of the parent generation.

The plant seed with its particular paraphernalia, whether within the fruit wall or not, is finally dispersed from the plant. According to the species, however, the seed may undergo a long period of dormancy before the young plant is released; that is to say, before the seed sprouts. Except for the embryonic plant itself, where in the animal kingdom is there any structure that corresponds to a plant seed? The plant fruit, the organ in which the seeds are born, is essentially the matured ovary; this is formed from the basal part of one or more carpels. A carpel is a specialized leaf (megasporophyll) and, whether it develops into a fruit or not, every carpel in due time is shed from the plant, just as every other floral leaf and every foliage leaf is also destined to fall.

Plant and Animal Cells

A word must be said of the biological cell, that unit of protoplasm or living substance which, in both plants and animals, seems to possess certain essential substances and properties. A typical plant protoplast is enclosed within a wall of cellulose. In the typical animal cell there is no such wall. A cell organ called a centrosome is characteristic of animal cells; but such an organ is found only in some of the lower plants. Certain cytoplasmic inclusions, such as plastids in many plant cells, and the Golgi material in animal cells, are among the characteristic differences, to cite only a few of the more general of these.

There is obviously no need to point out the self-evident differences in the bodily organization of, say, a horse and a great oak tree. Nevertheless a microscopic examination of plant and animal tissues, particularly those from very young or embryonic specimens, suggests similarities probably more than differences.

As already stated, the zygote or fertilized egg, is the cell which initiates the young or embryos of both plants and animals. The biochemist in his most refined analyses, as a rule, can point out only quantitative differences in the elements and compounds included in the protoplasmic constituents of zygotes or any other biological cells. The cytologist's examination of such cells, even under the most powerful microscope, leads to no definite conclusions. He sees no differences which would satisfactorily explain why the zygote of one species should develop into a sleek, slender, champing steed, and that of another into a mute, immobile, although venerable and lordly tree.

The biochemist, the biologist, and the philosopher are all faced with the same incomprehensible fact of life. This intangible, inexplicable mystery seems to defy explanation in terms of material substance. This is true whether the living object is an animal or a plant.

The burden of this paper is not a discourse on the problem of life itself; it is rather to consider a few of the more important biological functions as they appear in representatives of the two great kingdoms of living things. The distinctions should discourage any attempt to reduce to a common denominator the multiplicity of characteristic organs and processes which, in spite of certain similarities, are really fundamentally and manifestly distinct in the representative plant and the typical animal.

For reasons of sentiment and history enough misnomers and out-moded nomenclature are necessarily retained. Any attempt to apply some of this terminology literally and indiscriminately alike to plants and animals, is disastrous to scientific accuracy and may be the cause of serious errors. Space permits only this brief discussion. This cursory review will accomplish its purpose, however, if only it promotes a more serious and comprehensive consideration of the question:

"How much are plants and animals alike?" ●

[1]It will be recalled that the placenta of animals, an organ which is found only in the higher mammals, is a common envelope of vascular spongy structure which is formed by the interlocking of foetal and uterine tissue.

REFERENCES

1. Coulter, J. M., Barnes, C. R., Cowles, H. C. *A Textbook of of Botany*, Vol. II, (Ecology Grafting) American Bk. Co., N. Y., 1911.
2. O'Hanlon, M. Ellen. ***Fundamentals of Plant Science***, F. S. Crofts, N. Y., 1941.
3. Rabinovitch, Eugene I. ***Photosynthesis and Related Processes***, Vol. I, Interscience Pub., Inc., N. Y., N. Y., 1945.
4. Rahn, Otto. *Microbes of Merit*. Jacques Cottell Press, 1945, Lancaster, Pa.
5. Sharp, Lester W. ***Fundamentals of Cytology***. McGraw-Hill, 1943.
6. Sinnott, Edmund W. ***Plants Hold the Basic Patents***. Journal of Chemical Education, 23:35-36. Jan. 1946.
7. Transeau, E. N., Sampson, H. C., and Tiffany, L. H. ***Textbook of Botany*** (Grafting) Harper & Bros., N. Y., 1940.
8. ***A Symposium on Respiratory Enzymes***, (27 contributors) The University of Wisconsin Press, Madison, Wisconsin, 1942.

Bausch & Lomb Scholarships

• By Carl S. Hallauer
VICE PRESIDENT, BAUSCH & LOMB OPTICAL CO., ROCHESTER, N. Y.

Every conscientious teacher desires to further the progress of the pupils who come under his direction, especially the more talented ones. The exceptional student must be encouraged to continue his study even though financial assistance must be obtained.

Teachers and students alike will be glad to learn of the opportunity for college training that is offered annually to outstanding high school science students through the foresight and interest of one of the world's greatest optical companies.

The war showed us what tremendous progress could be made in applied science when scientists, military men, engineers, and industrialists worked in cooperation. Such progress, however, could not have been possible if our scientists had not previously accumulated a vast storehouse of basic and fundamental research.

Briefly surveying the postwar situation, we find that pure science as such was halted in 1942; that military service claimed the 150,000 college students normally majoring in the sciences and the 17,000 postgraduate specialists; and that many professors of physics, chemistry and allied subjects left educational institutions for industry. One of the immediate problems is, therefore, the development of a new generation of scientists.

Students at the Institute of Optics observing image formation with an optical bench. *Courtesy Bausch & Lomb*

It will be their responsibility to direct the great resources of science into the ways of peace, particularly so if the atomic bomb is conclusive proof of the fact that there must be no more wars.

Keenly aware of these considerations, the Bausch & Lomb Optical Company, in 1944, founded the Bausch & Lomb Science Scholarships at the University of Rochester. As their name implies, holders of these five annual scholarships are expected to follow undergraduate major courses in optics, physics, chemical engineering, electrical engineering, mechanical engineering, chemistry, mathematics, biology, geology, physiological psychology, or premedical work.

The stipend to the holders of the scholarships is $500 a year for three years, with the understanding that renewal for the second and third years of undergraduate study will be granted only if the record and conduct of the holders are maintained on the high level regarded as essential by the Scholarship Committee of the university. Each science scholarship has a cash value of $1,500 if each winner fulfills the requirements as outlined. The university will provide loan funds, if needed, for holders of the scholarships in their fourth year of study.

Eligibility to compete for the five annual scholarships is open only to those graduating seniors who have been presented the Bausch & Lomb Honorary Science Award Medal in their respective high or preparatory schools. Established in 1932, the honorary science award medal signifies that the winners led their respective high or preparatory schools in scholastic standing in science courses.

At present, there are 15 winners of the Bausch & Lomb scholarships at the University of Rochester, while 12 other Bausch & Lomb finalists have been granted other university scholarships of virtually equal value.

In 1944, the first year of competition for the science scholarships, 14 finalists, selected upon the basis of their completed applications, were guests of the university and Bausch & Lomb Optical Company for two days for interviews and tests. In 1945, there were 19 finalists from 11 states and the District of Columbia; and in 1946, 15 finalists from 13 states.

In commenting upon the scholar-

The Bausch & Lomb Honorary Science Medal Award.

ships, Dr. Alan Valentine, President of the University of Rochester, stated: "Pure science stopped during the war, and unless we get back to it in our university laboratories, applied science can go no farther. The United States must take the lead in this restoration.

"In sponsoring the Science Scholarships at the University of Rochester, the Bausch & Lomb Optical Company anticipated that need with exceptional foresight. Its program of honorary and financial recognition of outstanding high school science students already has greatly stimulated the youth of the nation to the opportunities for service and advancement in scientific careers." ●

Thoughts on Evaluation

(Continued from Page 73)

a scoring key with which to compare the answers written by pupils.

4. It is generally considered best to mark the papers on the quality of the answers from the standpoint of the particular subject in which the test is given. Such matters as English, spelling, and quality of handwriting are important, and improvement in them will be greatly augmented if all teachers will stress them. Nevertheless, a pupil's mark in chemistry or biology should reflect his achievement in the subject and not his ability in grammar or penmanship.

In the construction and use of objective types of tests a number of suggestions may be given.

1. Use a large number of items or questions. An objective test consisting of ten or fifteen true-false questions is worth very little. The reliability in such cases is so low as to make the results of very limited or doubtful value.

2. Do not take sentences verbatim out of the textbook for objective test items. This encourages memorizing and parrot-like repetition. Try rather to express the thought of a paragraph or the meaning of a principle in a question so that the pupil is required to do some thinking in answering it.

3. Avoid trick questions and expressions which make the meaning of the question obscure. The intent should not be to puzzle or propound riddles, but to test achievement in science.

An illustration of this point might be the following:

True or False? The formula for sulphuric acid is not H_2SO_4. Even the superior graduate student in chemistry might find himself momentarily nonplussed by the statement. He knows the formula for sulphuric acid as well as he knows anything, but as the question is stated he may find it confusing. However, let us change the form of statement thus:

True or False? The formula for sulphuric acid is H_2SO_4. Now the item is easy for anyone who knows the formula for sulphuric acid, and that is what we want to test.

4. Try to test the things which are considered to be important purposes of instruction whether they be knowledge, skills or attitudes. Obscurity of material is no recommendation for its use in a test. There are so many important outcomes to be measured that there is no time to be wasted on things that do not matter.

In closing, it may well be repeated that evaluation is an important and inescapable responsibility of every teacher and that it should serve the purposes of instruction and not determine them. If teachers of science will recognize the significance of this responsibility and strive for improvement, it will have a very desirable effect on the quality of their teaching. ●

Injuries in Athletics

• By James W. Macdonald, B.S., M.D. *(University of Pittsburgh)*
DIRECTOR OF STUDENT HEALTH, DUQUESNE UNIVERSITY, PITTSBURGH, PA.

Fathers and mothers and school officials are acutely conscious of the toll in injuries that football and basketball take each year. Some athletic injuries cannot be prevented. Others are wholly unnecessary and can be avoided by observing proper precautions.

Dr. Macdonald supervises the health of all Duquesne students including the members of the football and basketball teams. He outlines here some simple rules that every school can and should follow.

The safety man on your school's football team won't help you toward a state title very much if he roams around in the secondary defense thinking of safety first. Nor will he be of much help, either, if he is sent into a game for which he is not physically fit, for which he has been inadequately equipped, or in which he makes nonsensical grand-stand plays of bravery. In the former instance, it will be felt that he lacks the competitive spirit and, therefore, should be removed from the game. In the latter, circumstances over which he may or may not have control will predispose him to physical injury, which will mean his loss to the team and his absence from classes for many school hours.

In order of their importance, the sports which are responsible for athletic injuries are as follows: *For high school students:* touch football, heavy apparatus gymnastics, football, lacrosse, wrestling and tumbling, soccer, and crew. *For college men:* football, horse polo, wrestling, lacrosse, soccer, and crew.

Just as is true with disease in general, the *real* treatment of athletic injuries begins with their *prevention.* This is assured by:

(1) General and thorough physical examinations of the participating players conducted at periodic intervals.

(2) The provision of adequate, well-fitting equipment for each player.

(3) The immediate treatment of any injury.

Strenuous physical exercise undoubtedly exerts a constitutional effect. Circulatory changes are manifested by increased blood pressure, pulse rate, and cardiac stroke volume. It does not follow that contestants so affected are predisposed to the so-called "athletic heart", which is a questionable entity anyhow. The profuse perspiration and the concentration of urine following exercise is another reflection of the same image. The respiratory changes are essentially those of an increased rate of oxidation, which implies a faster respiratory rate and a more rapid oxygen utilization by the active muscles.

Along with these changes, the white blood count often tends to rise slightly, the blood volume to increase, and the blood sugar level to be elevated above normal. Many of these changes are probably related to the elaboration of increased amounts of adrenalin into the blood stream, incidental both to the apprehension prior to the game and to the increased rate of carbohydrate metabolism throughout the contest.

The musculoskeletal systems show evidence of muscular hypertrophy and strengthening of the tendons and ligaments about the joints.

The normal, healthy adolescent or young adult can reasonably be expected to endure the hazards of strenuous sports without undue risk. Two modifying factors immediately present themselves. First, the equipment which the player is given must fit him well and protect him adequately from the more obvious dangers of the sport in which he is engaged. Poorly fitting football helmets or shoulder pads are worse than none at all. Considered from another angle so-called *defensive* equipment, such as thigh pads in football, often turns out to be *offensive* equipment in that such pads are more likely than the unprotected thigh to be the immediate cause of an opponent's fractured clavicle. The second modifying factor in the healthy competitor's ability to withstand the hazards of the sport is his own common sense. If he insists on taking undue risks against the urging of his coach, only God and the referee can help him. The latter usually will not intervene until the player lies prone on the field.

So far as the types of injuries encountered in athletic contests are concerned, mention may be made of:

1) Sprains of joint ligaments and dislocations.

2) Strains of muscles along with bruises and contusions of the skin and underlying connective tissues.

3) Fractures.

4) Internal injuries.

Sprains, strains, and fractures are the most common, but internal injuries are apt to be more serious so far as immediate prognosis is concerned. In this connection, we must keep in mind brain lesions resulting from head injuries, perforated lungs due to fractured ribs, etc. The treatment of each particular injury must be immediate and adequate if it is to be effective. It is not the purpose of this paper to outline the specific treatment of

(Continued on Page 93)

Education, A Medium of Conservation

• **By John W. Scott, Ph.D.** *(University of Chicago)*
DEPARTMENT OF ZOOLOGY, UNIVERSITY OF WYOMING, LARAMIE, WYOMING

Rich America has long carelessly wasted its wealth of forests, waters, wildlife, minerals and soil. It must not continue to do so.

Man must understand his place in nature, and strive to learn how to protect our natural resources, and preserve, restore, and use them wisely.

We have needed a broad national policy on conservation education. One is now in the making. The Chairman of the National Committee on Policies in Conservation Education discusses what has already been accomplished through the Isaak Walton League and allied organizations, and what the Committee hopes to achieve in the future.

We cherish the glorious privilege of being an American citizen. In this connection we usually think of political freedom and opportunity. Until rather recently we have seldom thought of the rich opportunities and privileges found in America, as based primarily upon the wealth of the natural resources of this great land. The use of these resources has made possible the high standard of living which we enjoy. The wise use of these resources will determine the standard of living for generations to come. To use wisely these resources an enlightened and vigilant citizenship is necessary.

To those living less than a century ago our natural resources seemed inexhaustible. With no more lands to homestead; with the depletion of our forests, which is currently felt in a shortage in building materials and paper; with reduced fertility of farm land due to erosion of top soils; with many of our mineral resources rapidly being exhausted; with pollution of streams and rivers by sewage and industrial wastes a national disgrace, a menace to human health, and destructive to aquatic life; with many species of wild life greatly depleted or rapidly disappearing; we keenly realize that the resources upon which our civilization depends, not only can be, but are being seriously depleted or destroyed.

After the first World War, when the wastage of resources was deeply felt, the Isaak Walton League of America was founded as a "Defender of woods, water, and wildlife." One of the objectives of that organization is "To promote means and opportunities for the education of the public with respect to such resources and the enjoyment and wholesome utilization thereof." With this in mind the Executive Board of the League in 1945 organized a committee on conservation education, with two primary objectives: A group of educators and conservationists was asked to formulate the objectives of a national policy of conservation education and to devise ways and means by which this policy could be put into effect, and become a vital part of the school program.

Three meetings of this committee have been held; the first on September 18, 1945, the second, January 18, 1946, the third in Buffalo, New York, June 28-29, 1946. A progress report of the committee was presented at the twenty-fourth anniversary meeting of the League in Chicago, March 28, 1946, under the title, "A National Policy of Conservation Education." The substance of this report was also presented by the chairman of the committee, before a meeting of the National Association of Biology Teachers in St. Louis, March 30. Some of the high lights of this report follow:

Conservation education should be taught at all age levels in terms of the interdependence of human life with animal life, plant life, water, soils, mineral resources and environment.

It should involve the development of a program, considering the needs of civilian life, from pre-school age throughout adult life, and a wise use of natural resources from raw materials to the junk pile.

A principal outcome of a national policy should be an attitude emotionalized and rationalized in favor of the conservation of national resources. There is urgent need for a national awareness and concern over education in conservation by the average citizen.

Conservation must be approached from the citizenship angle. Certainly, the approach that should be stressed is that of citizenship, rather than the utilization of our excessive interest in special areas, such as forestry, agriculture, wildlife, or nature study. However, interest in a specific area may be an effective *means* of achieving the broader objective. All teaching should stress the ultimate good—human welfare.

Curriculum construction is a local problem, and the curriculum of a school should be constructed by that school, but outside agencies can assist in many ways. Only people actually in education can be the "front line troops" in this activity; all others must constitute the support or "services of supply".

Conservation education should be implemented into existing curricula by methods devised by educators who know the programs of the schools and the abilities of the students at each grade level, with special consideration for geographical location and urban as well as rural needs.

Major consideration should be given to two bottlenecks: first, a program of teacher training or teacher education; and, second, public opinion and sympathy. A most urgent need is for teacher training in this field. Particularly there is need for in-service training through intensive short institutes and workshops. Emphasis should also be placed upon the pre-service and in-service education of teachers to make them conscious and qualified in this field, and stimulated to the extent that they will actively participate in such a program of instruction.

There should be an adequate extension service for the improvement of established leadership. Adult education needs greater emphasis, not only because the need of conservation is too urgent for us to wait until a new generation is trained, but also because it is only as public opinion supports it that conservation education in the schools can be effective.

Careful attention should be given to presentation of conservation material and procedure in teacher training. Conservation instruction should be approached when feasible, desirable, or possible, largely through laboratory or project methods rather than through text books or pure theory. First-hand experience with the environment should be a part of the educational opportunity offered to all children.

Agencies engaged in conservation education should work toward creating a harmony of interest and attitude among conservation organizations that will tend toward a common goal for the benefit of all. Coordination in conservation work by federal, state and private agencies is needed.

Different approaches to the problem of conservation are necessary in dealing with rural and urban pupils. Both are important. In developing local programs, wide use should be made of community resources, both those represented by the natural environment and the technical knowledge and abilities possessed by members of the community. Actual participation by children in the conservation program is absolutely necessary.

Authoritative publications giving pertinent facts necessary in a conservation program should be planned. A special need exists for well-prepared textbooks and other suitable materials for classroom use. Manuals are badly needed. All these should incorporate authoritative materials prepared by conservation experts. Likewise, suggestive materials should be prepared on the organization of the curriculum. Additional research is needed.

We should avoid legislation which makes teaching of conservation mandatory. We want to emphasize voluntary action which grows out of knowledge and understanding. Conservation education can be aided by legislation, but should not be legislated into being.

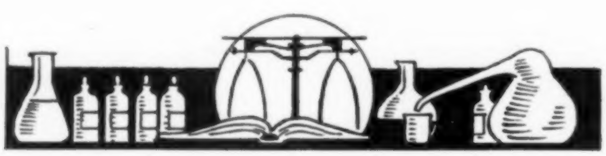
On March 30, the National Convention of the League endorsed the work of this committee, and voted to continue support. The minutes of the meeting in Buffalo are not yet available, and details cannot be given here. However, the discussion centered about the following items: (1) Formulation of a brief, concise statement regarding a national policy of conservation education, (2) Preparation of a rather comprehensive statement dealing with the points to be included in the national policy of conservation education, (3) A statement of suggestions which the committee proposes for implementation of the general policy agreed upon.

The title of the committee was changed, with the approval of the Executive Board of the League, to read as follows:

"The National Committee on Policies in Conservation Education.

A cooperative activity of conservation, civic, scientific and educational organizations."

This will permit any interested organizations of national, regional or state character, to have a part in formulating a national policy. It is contemplated that no organization will lose its identity or have its autonomy restricted in any way. Nor will it be obligated to follow the policies agreed upon by the committee. In other words, this is expected to be a voluntary organization with a common objective, the welfare and benefit of all mankind; implemented through an understanding of man's place in nature and the protection, preservation, restoration and wise use of natural resources. To achieve conservation in education is worthy of the keenest thought that can be given to it by teachers of all subjects, at all levels of education. In a democracy, continuous national welfare is closely dependent upon an enlightened citizenship and their ability to make wise use of available natural resources. ●



Plant Science in a Garden

(Continued from Page 72)

The crop is harvested as soon as it is ready, and therein is the most effective motivation for regular attendance through the summer. Every child appreciates his crop whether the particular vegetable in question is a favorite, or not.

The greater the variety of plants in a garden, the longer the harvest. As the young people begin to realize this fact, their plans include intercrops and succession plantings so that all the land is working all the time. Lettuce plants, onion sets for scallions, or radish seeds are planted early where tomato or pepper plants are to be put in later. The plots are too small to permit more than one planting of corn, but second plants of beets, carrots and beans are usually successful and add zest to the end of the season's harvest. During the summer, the children compare their original plans with the growing gardens, and it is often possible to have them make a rough draft of a better arrangement for the next time.

As plants grow up to maturity there are endless opportunities to point out to the students how the plants function as living things and how each part is important to the plant's life without regard to the use man makes of it. Time and time again, children have asked if they should remove the white flowers from the beans. Usually the teacher can help them trace the life story of the plant in question through the material in their own or nearby gardens, but once in a while a child must learn by real disappointment. Tom complained that he had no tomatoes on his plants. Inspection revealed that there were no blossoms either. No one could understand, for the plants were quite healthy and all the plants in adjoining gardens were fruiting heavily. At last the difficulty was discovered. Tom was carefully removing every blossom because he said he did not like the little yellow flowers.

Cucumbers and corn are endlessly fascinating to all ages who know the vegetables well but have never seen the plants growing. Two kinds of flowers on the cucumber are baffling at first. Tassels and ears of corn are so different in form from any flowers or flower parts that are familiar that parents, too, are brought into the garden for a lesson on "how the corn grows".

While the children's individual gardens are devoted entirely to vegetables, a long border on the west side of the field is a picking garden from which each child has flowers several times during the season. Most of the common annuals are included in this area and many kinds of perennials are used in the foundation plantings around the Garden House and at the south end of the field. It is not unusual for older students to recognize sixty or more different kinds of flowering plants because they are a part of their natural surroundings and discussion of them becomes a regular part of everyday conversation.

From time to time groups meet in classes to study flowers and learn something of botanical classifications. Plant families like the *Cruciferae*, *Compositae*, and others with representatives in both the vegetable and flower gardens are interesting ones for young people to observe. Weeds as plant relatives of garden flowers and cultivated plants come into new perspective in this kind of plant study. Plants of the legume family with their characteristic forms of root nodules formed through the action of soil bacteria give rise to innumerable questions about nature's methods of soil improvement and the microscopic plant forms that aid man as well as hinder him in his efforts to raise plants.

Sometimes the microscope itself goes into the garden to reveal the wonders of these tiny forms. No abnormality among the garden plants attracts more interest than the corn smut, and the fact that it, like the mushroom, is an edible fungus is a never-ending cause for amazement.

The inter-relationships in the natural world among plants, insects, birds, reptiles and small animals, etc., fit together like the pieces of a puzzle. Every day new questions arise. To some the answers can be immediate; for others the children seek the aid of books, or perhaps they learn to wait until the answer grows.

For children who have wide access to the world of nature, a garden may be less exciting but none the less valuable as a laboratory for plant science.

There are innumerable ways of organizing such an activity for young people. No one plan will cover all the varied situations and conditions under which it might be undertaken successfully, but certainly some or all of the following factors have contributed to the progress of the Garden that has been operated here through thirty-three consecutive seasons:

1. A schedule that begins with spring and is maintained through the major part of the growing season
2. Sustained adult supervision
3. A variety of crops with a succession of harvests
4. A site that is favorable for plant growth and tools that are suitable for the children who use them
5. Consideration for the training and development of the individual child in a social situation.

Gardening is a creative experience, not a synonym for a hard and monotonous chore. ●

Virus Diseases

(Continued from Page 70)

gut wall to the virus of maize streak. If the gut wall of an inactive insect is punctured before or shortly after it has fed on diseased plants, then the insect, in due time, is able to transmit the disease, and virus may be detected in its blood. If the gut wall is not punctured, the insect is unable to transmit.

Not much is known about the nature and properties of persistent viruses for it is difficult to isolate and study them when they cannot be transmitted by mechanical means. The major strides toward an understanding of the nature of virus have been made with the mechanically transmissible ones, and specifically with mechanically transmissible viruses that are sufficiently stable to remain active for long periods outside their hosts. Most of the early work was done with tobacco mosaic virus because of its unusual stability. In 1916, Allard allowed the sap from diseased tobacco to flow through a Livingston atmometer cup and observed that the virus was too large to pass through the pores. He thus showed that the virus is particulate and not a fluid as had been suggested by Beyerinck's living contagious fluid theory. An early estimate of the size of tobacco mosaic virus particles was obtained by Duggar and Karrer (1921) who studied the filtration of the virus through ether-alcohol-collodion membranes with different pore sizes. It was concluded that this virus is about 30 millimicrons in diameter. Later filtration studies by other workers reduced this estimate to 15 millimicrons.

Making use of the fact that rod-shaped particles in a flowing solution become oriented with their long axes parallel to the direction of flow, Takahashi and Rawlins (1933) obtained evidence that tobacco mosaic virus consists of rod-shaped, rather than spherical or plate-shaped, particles. Exhaustive studies on tobacco mosaic virus by means of sedimentation in an analytical high speed centrifuge, diffusion, viscosity, and x-ray diffraction, and by electron microscopy have shown that the particles are indeed rod-shaped, and that they are about 15 millimicrons in diameter and 280 millimicrons in length. Tobacco etch virus is also rod-shaped but tomato bushy stunt, tobacco necrosis, tobacco ringspot, and southern bean mosaic viruses are spherical, or nearly so.

In 1935, Stanley announced the isolation of a protein possessing the properties of tobacco mosaic virus, that this protein had been obtained in the form of needle-shaped crystals, and that, therefore, tobacco mosaic virus was a non-living chemical molecule. A number of other viruses have been isolated in crystalline form since then and have been demonstrated to consist mainly, if not entirely, of nucleoprotein. It is now pretty generally accepted that viruses are mainly protein in composition but the question of whether they are living or non-living is a matter of controversy. They can be handled in many respects like chemical molecules but they have many properties in common with microscopic organisms. At various times they have been called non-living molecules, living molecules, transition forms between the animate and inanimate, and ultramicroscopic organisms; they have been represented as an evolutionary stage in the development of microscopic organisms, as degenerate parasitic organisms; they have been likened to genes, and their development from the chondriosomes (preplastids) of cells has been postulated. Interesting as these theories may be, the fact remains that there is as yet insufficient evidence for distinguishing between their living and non-living nature or for establishing their origin.

One of the interesting properties of viruses is their ability to mutate—to produce variant strains similar to the original virus but differing from it in one or more respects. The ability to mutate was first shown for tobacco mosaic virus by Jensen (1933) and has since been confirmed for this and other viruses by numerous investigators. The process of mutation is continually going on in nature and it results in a multiplicity of forms of specific virus diseases. Some of these forms are rather mild and cause little injury to their hosts while others are severe. It has been suggested that important crop plants might be saved from destruction from a severe virus disease by infecting them early with a mild strain of the same disease, very much as man may be protected from the ravages of smallpox by infecting him with cowpox. While this sort of protection of plants is theoretically possible, there are certain practical considerations which tend to make it uneconomical or potentially dangerous and it has not been attempted on a large scale as yet.

The control of plant virus diseases poses a real problem for the plant pathologist. Since most of these diseases are transmitted by insects, control methods are, of necessity, directed toward the control of the vectors, the destruction of sources of virus for the insects to feed upon, or the development of resistant or immune varieties of crop plants. While it may be a relatively simple matter to control insects to the point where they are no longer injurious in themselves to crops, it is difficult to reduce their population to such an extent that they are of little importance in the spread of disease. Control of the insect vector may lower the incidence of disease but does not eliminate it altogether. Only in specific cases is it possible to eliminate the disease by controlling the vectors. For example, if an aster planting is surrounded by a five foot fence of fine wire screen or cloth the insect vector will not fly over the fence and the crop inside the enclosure will remain free from yellows.

The destruction of all diseased plants as quickly as they appear will reduce the spread of virus diseases and thus prevent losses from disease. However, infected plants may serve as a source of virus for insect vectors long before they can be diagnosed as obviously diseased. Moreover, many perennial weeds serve to carry viruses through the winter months and provide a source of infection throughout the growing season. The elimination of sources of infection is difficult or impossible in many cases; attempted elimination, at best, serves to lower

the number of infections rather than to prevent infection altogether.

One of the most promising ways of controlling virus diseases is through the development of resistant or immune varieties of commercially desirable crop plants. The introduction of resistant varieties of sugar beets has made it possible to grow a crop in regions where the curly top virus is abundant. The use of resistant sugar cane varieties has restored production of sugar from cane nearly back to the level it reached before mosaic became prevalent. A new hybrid tobacco offers promise of tremendously reducing losses from tobacco mosaic. This is a hybrid developed by Holmes from a cross between *Nicotiana glutinosa* and *N. tabacum*. *N. glutinosa* has the ability to localize tobacco mosaic virus at the point of inoculation. Holmes found that this ability was controlled by a single dominant gene which, by hybridization and suitable backcrosses, could be incorporated into commercially desirable varieties of tobacco. In some districts, the old standard varieties of tobacco have been replaced by the new hybrid with the consequence that tobacco mosaic is no longer an important factor in the growth of the crop. Moreover, the quality of the tobacco produced does not seem to have been impaired by the incorporation of the gene for localization of the virus.

Plant viruses are of importance to man because of the limitations they place on the production of food for his sustenance, of ornamental plants for his esthetic enjoyment, of fibers and other plant derivatives used in manufacturing products of service to him. Plant viruses are also of importance to man in another, and quite different, way. Knowledge gained from studying them can often be directly applied in formulating a better understanding of the viruses that infect man himself. The methods developed in the isolation of tobacco mosaic virus from the sap of diseased plants pointed the way toward the isolation of influenza virus and other destructive viruses of man.

The demonstration that plant viruses mutate, giving rise to mild as well as severe strains, suggested possibilities for the development of vaccines useful in protecting man from the ravages of virus infections. The interference phenomenon—the demonstration that one strain of virus will protect plants from more severe strains of the same virus—opened another avenue along which methods for the control of man's virus enemies might be pursued.

These are only a few of the ways in which the study of plant viruses has contributed to the advancement of knowledge concerning human viruses. Much remains to be learned about the nature of these agents. It is virtually certain that work with plant viruses, among its other accomplishments, will continue to pioneer in an understanding of the fundamental nature of these tiny pathogenic agents. ●

Electron Microscope

(Continued from Page 68)

fibrous protein of connective tissue, skin and tendons), myosin and other fibrous proteins of muscles, fibrin (the protein which composes blood clots), stromatin (the matrix of the membrane which encloses the red blood corpuscles) and a number of others.

Cellulose and other carbohydrate fibers which are of great commercial as well as academic interest have also been studied in some detail.

In the short space of only five years many other biological objects have also been studied with the electron microscope. These, with the examples mentioned above, demonstrate the revolutionary impact of electron microscopy on biological and medical concepts. Many chapters will soon have to be completely rewritten. Great and thrilling experiences await the properly prepared student embarking on a career of research in biology, for it may confidently be predicted that we are on the threshold of the greatest era of discovery in the entire history of biological science. And the electron microscope, with its associated techniques, will undoubtedly prove to be one of the most formidable tools in the experimental repertoire of the biological investigator in the years to come. ●

Bird Banding

(Continued from Page 76)

It is well for all bird banders to stress to any group they may have the opportunity to address on birds or bird banding, the importance of looking for bands on the legs of dead birds. The author never misses a chance to explain bird banding to any interested group, and especially to school children and scout groups. It is easy to gain the cooperation of children in looking for and reporting banded birds that might be found dead along a highway or elsewhere. All that is necessary is to send the complete band number to the Fish and Wildlife Service, Washington, D.C. A penny post card will suffice. If possible, the cause of death and the approximate date of death of the bird should likewise be given, as well as the species, if that is known. When such a report is received in Washington, the persons in charge first check to see to whom the band was issued. Then they look through the file of reports from that bander to see on what bird the band was placed. The person who found the bird will then receive from Washington the following information: The kind of bird it was; when, where, and by whom it was banded; whether it was a young or an adult bird, whether it was male or female, and how it was originally caught,—for these are the things which the bander must include in his semi-annual report on every bird banded by him. A second report will be sent from Washington to the bander telling him when, where, and by whom his banded bird was found, as well as the cause of its death providing that information was reported to Washington. In case a bird bander lives near the person who finds a dead banded bird, it is better to report the band number to that bander, because most likely the bird was banded by him, and he will have the information on hand concerning the dead bird.

The fact that many birds repeat frequently shows that they are not shy of the trap, but merely know where to get a free meal. Several years ago I caught a Black-capped Chickadee over 30 times within a few weeks, and one Indigo Bunting was caught in my traps three times within a half hour. Quite a few of our banded birds are caught as station Returns for several successive years. The very first Cardinal which we banded on May 17, 1941, has been caught in our traps every year since then, and sometimes several times in the same year. This male Cardinal was an adult when first banded, so it must have been born at least in 1940, which would make it at least six years old now. The last time it was trapped was during the Graduation Exercises at St. Joseph's College on June 2, 1946. This fact lead someone to observe that perhaps the Cardinal thought he'd report for his diploma after so many years on the college campus. Since the Cardinal is usually classed as a permanent resident the year-round, the chances are great that this individual has seldom, if ever, left the vicinity of the campus since its birth six or more years ago. This Cardinal, however, does not hold an old age record, for a certain bird bander along the East coast has record of a Cardinal which is over 13 years old.

Although we have but few Recoveries to boast of, some of our banded birds have traveled quite far from our campus. We have received reports of some of our birds having been found in the following states: Florida, Mississippi, Georgia, Louisiana, Ohio, Missouri, Illinois and Indiana. Four birds, all Starlings, were found in Canada several months after we had banded them. The greatest distance from St. Joseph's College that any of our birds has been found is a little over 1,000 miles.

A few of the species of which we have banded large numbers in the past five years are: White-throated Sparrow 2,400; Slate-colored Junco 1,983; Starling 1,480; Robin 889; Purple Martin 394; Barn Swallow 328; Mourning Dove 313; House Wren 270; Blue Jay 184; White-crowned Sparrow 114; Brown Thrasher 100; and Cardinal 91. ●

NEW BOOKS

Illustrated Technical Dictionary

• *Edited by* MAXIM NEWMARK. New York: Philosophical Library, Inc. 1944. Pp. vi + 352. $5.00.

In any active school library this book will soon become thumbed and dog-eared. Students in technical and vocational courses will find it especially useful. Teachers and students of general science as well as of the specialized sciences will consult it frequently.

This dictionary offers a large number of standard definitions that in most cases have been officially approved by various engineering, technical, trade, and industrial organizations. Emphasis has been placed on subjects that are fundamental to several fields of specialization. Practical applications have not been overlooked. Aeronautics, radio, plastics, automotive mechanics, shipbuilding, air and marine navigation, meteorology, photography, and surveying are considered. So are mechanical drawing, metallurgy, machine shop, carpentry, foundry, art and design, printing and bookbinding, ceramics, and many other fields. The illustrations are largely detailed and labeled line drawings. Charts, ideograms and tables provide additional information.

H.C.M.

Racial Myths

• *By* SISTER MARY ELLEN O'HANLON. River Forest, Ill.: Rosary College. 1946. Pp. 32. $0.25.

"Be clear. You are not writing for experts."

The author has followed admirably this sensible admonition—too often ignored by those who write for students.

The timely question of race prejudice is irrefutably answered with a complete absence of rancor, and, considering the readability of the work, with a scientific thoroughness that does great credit to the author.

Instructors in social studies or moderators of study clubs will find this brief work an invaluable aid in helping to promote right thinking on the plaguing subject of prejudice, which seems about to rear its ugly head again.

Rev. John T. O'Brien, C.S.Sp., Duquesne University.

Volcanoes New and Old

• *By* SATIS N. COLEMAN. New York: The John Day Co. 1946. Pp. vi + 222. $3.75.

The author of this book, newly interested in the subject, set out to write a simple but fairly comprehensive and up-to-date book that would satisfy the public's growing interest in volcanoes. She has done it well. The book does not pretend to be a scientific treatise. It is, rather, an interest-stirring story that will appeal to general readers at all age levels. It is centered about Paricutin, the volcano which broke forth early in 1943 on a farm in Mexico. A graphic account in pictures and words of this volcano's birth and history lead into a consideration of the causes of volcanic activity, and a study of volcanic materials, and the several varieties of volcanoes and craters. An outline of the distribution of volcanoes throughout the world is followed by brief stories of some four score volcanic eruptions of note that have occurred during the past twenty centuries. Nearly 100 illustrations and two maps add to the interest and value of the book. Teachers and students who read it should be stimulated to further study.

H.C.M.

Hackh's Chemical Dictionary

• *Edited by* JULIUS GRANT. 3rd. Edition, Philadelphia: The Blakiston Company. Pp. xii + 925. $8.50.

This illustrated book of nearly 1000 pages contains some 57,000 entries dealing with chemistry and a number of related scientific and technical fields including among others physics, biology, medicine, pharmacy, geology, mineralogy, industry and commerce. Many of its definitions are brief and concise, but wholly clear; others are encyclopedic in character. Chemical rules, laws and theories, apparatus and equipment, chemical elements and compounds, drugs, minerals, and animal and plant products are discussed. There are numerous tables of data, and more than 200 illustrations and diagrams. The book is well printed, the binding sturdy.

This dictionary is a highly acceptable reference aid. The fact that since its first publication it has passed through several printings and two editions indicates that the present third edition will be welcomed cordially by workers in science and industry.

H.C.M.

Physics of the Twentieth Century

• *By* PASCUAL JORDAN. New York: The Philosophical Library. 1944. Pp. xxi + 185. $4.00.

It is interesting that Planck's quantum theory, on which 20th century physics is founded, was published in 1900, just before the dawn of the century. No other scientific development of modern times has made necessary such a profound revision of the previously held ideas, and hence none has produced comparable changes in the underlying philosophy of the science.

It is Philosopher Jordan more than Physicist Jordan who discusses the quantum theory—its background, its significance, and its implications—in these pages. First he reviews Galilean - Newtonian mechanics as background for the revolutionary changes of the quantum

mechanics. The entire development is non-mathematical, but the reasoning is "tight"; hence the book, though interesting, is by no means light reading.

Anyone with a fair knowledge of general physics should be able to read this discussion with profit. Serious students of physics or chemistry may well spend hours, days, even years, developing these fundamental concepts and their implications.

Other aspects of modern physics—relativity, cosmic rays, etc.—are also treated, but much less extensively than the quantum theory.

T.H.D.

Physics

• *By* WALTER G. WHITMAN and A. P. PECK. New York: American Book Co. 1946. $3.00.

The reviewer sometimes wishes that he could re-live the days when he was first being introduced to physics by reading, for fun, a high school text in the subject. He remembers clearly the feeling of excitement he experienced as one phenomenon after another was presented and explained. He was fortunate in having available a text that satisfied his curiosity and stimulated his imagination, and he feels that a present-day student using Whitman and Peck might have the same experience.

What better can be said of this or any other high school text than that it stimulates the imagination of the curious student? All aspects of elementary physics are included. The emphasis, as measured by the number of pages allotted, is on those subjects (electricity, mechanics of machines, etc.) which high school boys usually find most exciting.

The book is illustrated with 685 photographs and diagrams. While many seem to have very little point in illustrating physical principles, they will no doubt be of interest to high school students.

The publisher has done his job well and is to be congratulated especially on the very attractive appearance of the volume.

T.H.D.

Emulsion Technology

• *2nd Edition.* Brooklyn, N. Y.: Chemical Publishing Co., Inc. Pp. 360. $6.50.

This edition, written by a number of contributing authors, attempts to embrace every aspect of emulsions and emulsifying agents. It succeeds rather well. A good feature of the book is an up-to-date classified list of emulsifying agents, giving their chemical names, chemical composition, the type of emulsion they help to produce, physical properties, and suggested uses. Besides a comprehensive section on the theory of emulsions and emulsifying agents, there are data and formulations of many emulsions in such fields as drugs, cosmetics, foods, paints, coatings, waxes, etc.

Charles H. Becker.

Injuries in Athletics

(Continued from Page 84)

each type of injury. Our object is to stress the nature and predisposing factors of injuries in athletics. The responsibility for the treatment of such injuries devolves upon the team physician.

In practically all phases of athletics a man is considered "aged" by the time he has reached forty, notwithstanding our having been told that that is when life begins. The reasons for man's decreased efficiency as a combat infantryman, professional fighter, or football player after he has passed his third decade is probably to be found in the aging of his connective tissues, their diminished resilience, and the exhaustion of the elasticity of the blood vessels, the articular capsules, and the muscles.

A second important factor is the psychic one, the increased pressure of business and family responsibilities at the consequent expense of the zest with which the man had previously entered into competitive sports. A discussion along this line would of necessity lead into the nature of the aging process. This subject is, unfortunately, most vague at the present time. Perhaps the Russians with their recently highly publicized antireticular cytotoxic serum (A.C.S.) have found the answer to the enigma. Interestingly enough, while newspapers were telling us of the alleged ability of A.C.S. to prolong man's life to 150 years, the discoverer of the serum quietly died in his seventh decade. Of course, the final evaluation of the clinical efficiency of A.C.S. will not be influenced by the death of Dr. A. A. Bogomolets. At present, except for rare physiological freaks, we must continue to consider the athlete as washed-up at forty.

With regard to the physical fitness of athletes, too much stress cannot be placed on the thoroughness and frequency of physical examinations by competent and conscientious physicians. Altogether too often is the law complied with by the doctor's hasty determination of the blood pressure and his casual observation of the heart sounds midst the bedlam of the noisy locker room before the fighter climbs into the ring. The same is frequently true of the examination of football and basketball players when they register at a university. The consequences of such standing-in-the-doorway physical examinations are to be found in the blinded and punch-drunk fighter, the limping old grid-iron star, and the occasional more dramatic picture of death on the field of sport.

Spectators seldom realize the neglect that has been responsible for the price these boys have paid. It behooves all of us to pay more attention to what goes on

in sports. The observance of the few simple precautions outlined here will result in fewer injuries to athletes and better sports programs for all. ●

REFERENCES

1. Lloyd-Deaver-Eastwood
   Safety in Athletics.
   W. B. Saunders Company, Philadelphia, 1937.
2. Preston, Lee S., M.D.
   Report of Intensive Laboratory Studies of High-School Athletics.
   New York State J. M., November 1, 1940, pp. 1599-1602.
3. Roesler, Hugo, M.D.
   A Roentgenological Study of the Heart Size in Athletes.
   The American Journal of Roentgenology and Radium Therapy, Vol. XXXVI, No. 6, December 1936, pp. 849-853.
4. Stine, Dan G., M.D.
   The Meaning of "Athletic Heart" Among University Athletes.
   The Journal Lancet, September 1938, pp. 405-415.
5. Thorndike, Augustus, Jr., M.D.
   Athletic and Related Injuries.
   The New England Journal of Medicine, Vol. 223, No. 5, August 1, 1940, pp. 180-185.
6. Editorial:
   Football Casualties
   The Journal of the Kansas Medical Society, February, 1936, pp. 61-62.
7. Editorial:
   Blood Circulation of Athletes.
   J. A. M. A., Vol. 130, No. 15, April 13, 1946, p. 1019.

Place of Science

(Continued from Page 78)

in the different fields of science. Further desirable next steps include a program of identification of superior practices now in progress in the schools with suitable publicity to distribute information relative thereto; the cooperative formulation of lists of consumer applications of the major principles of biology, physics, and chemistry; the cooperative formulation of a recommended group of topics and practices now prevalent in science which could most readily be reduced or removed as a means of providing increased time and attention for consumer problems; and other recommendations.

Another committee of the National Science Teachers Association, under the chairmanship of Professor Harold E. Wise, University of Nebraska, Lincoln, Nebraska, has completed a second consumer education study in the field of science. This report, also done in cooperation with the Consumer Education Study, is planned for release in the autumn of 1946. It deals with specific recommendations on the nature of consumer education materials supplied by business and industrial firms for classroom use. ●

Federal Aid

(Continued from Page 66)

Through the work of the Senate Military Affairs Committee, I am most familiar with the particular mechanism provided in the so-called Kilgore-Magnuson bill, which was reported to the Senate by the committee.

Of the several proposals, it is perhaps the most prominent, being the outcome of joint hearings on the Kilgore bill which emerged from studies of the sub-committee on war mobilization, and the Magnuson bill, which reflected the proposals of Dr. Bush.

It would support science not through operating facilities of its own, but through existing facilities, such as universities, government laboratories, and other non-profit institutions.

The committee reported: "In brief, the proposal is to use parallel staffs of full-time and part-time scientific personnel."

"The full-time staff is charged with the actual administrative responsibility for activities of the National Science Foundation (which the bill creates), but part-time non-Government scientists will participate actively in planning and evaluating all programs of the Foundation."

Within the foundation would be the following divisions: Mathematical and physical sciences, biological sciences, social sciences, health and medical sciences, national defense, engineering and technology, scientific personnel and education, and publications and information. Three additional divisions could be added when deemed necessary.

One of the outstanding features of the Foundation's work would be in the field of scholarships and fellowships.

As the report states: "Almost every witness urged the provision for a broad program. Evidence shows that as a result of drafting science students during the war, the Nation is faced with a serious deficit in scientific personnel, which must be made up if American science is not to lag.

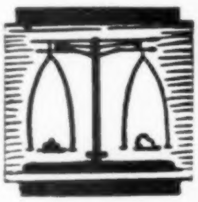
"This . . . would provide not only for undergraduate scholarships but for graduate and postdoctoral fellowships such as have been so successful in the experience of the National Research Council and the Social Science Research Council. Recipients of these awards are to be chosen solely on the basis of aptitude for scholarly pursuits.

"It has not seemed wise to include specific provisions governing the procedure for selecting recipients . . . not to specify the mechanics by which this program would be administered. To assure an equitable geographic distribution of funds, provision is made to permit the establishment of state quotas."

These financial aids to study would be given to individuals rather than to institutions so that the student might study at a recognized institution of his own choice.

What final form such legislation may take is not certain at this writing.

But it is certain that the time for action has arrived. To quote Dr. Bush, it must be early action, "if this nation is to meet the challenge of science in the crucial years ahead. On the wisdom with which we bring science to bear in the war against disease, in the creation of new industries, and in the strengthening of our armed forces depends in large measure our future as a nation." ●



Service from Lantern Slides

(Continued from Page 74)

slides, 35-mm. filmstrips, and microscope slides as well as regulation lantern slides. Changes from one type of projection to the other can be made, after a little experience, in not to exceed fifteen seconds.

With power enough to produce visibility in a fully illuminated room, the more opaque slides would be endangered by the accompanying heat. Ventilating fans are expensive, water cells increase the weight and decrease the portability of projectors, and the usual type of heat-absorbing glass will fracture at the equilibrium temperature. Mr. Dutton has however discovered a type of heat-absorbing screen that provides complete protection to the most opaque slides and that will "stand up" under the most extreme use.

These are a few of the problems that required solution before screen illustrations could become as casual in the classroom as are printed cuts in our books and magazines. But the biggest problems of all lie in the field of production and distribution. Plans are under way to prepare basic booklets of cellophane slides, one for each of the major fields of science, to be cut and mounted between glass covers by the users. In addition, one journal has already expressed a willingness to reprint inserts on cellophane of such of its illustrations accompanying current articles as would be most useful to teachers and to bind these inserts with the journal. In this way teachers could keep their slide collections up to date.

If the reaction of teachers to this improvement in the use of classroom illustrations should prove encouraging, it seems likely that further developments would follow. One obvious opportunity for such development would be the extension of the cellophane printing process to halftone reproductions. But the solution to that problem, along with some others, is not yet in sight. It will be hastened by quick recognition and early acceptance of the new teaching resource as far as it goes. ●